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Preliminary

PLANT ASSOCIATIONS and HABITAT TYPES of the North Bend Ranger District Mt. Baker-Snoqualmie N.F.

USDA • Forest Service
Pacific Northwest Region

PRELIMINARY PLANT ASSOCIATIONS

AND

HABITAT TYPES OF THE

GREEN AND CEDAR RIVER DRAINAGES

NORTH BEND DISTRICT,

MT. BAKER-SNOQUALMIE NATIONAL FOREST

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PREFACE

This document represents the first approximation toward a comprehensive vegetation-site classification for this area. Organization and naming of the types should be viewed as tentative until field checking of keys and quantitative verification of types is completed. Preliminary results are presented in this form as a working tool in the process of development of the Area Guide. Feedback on the usefulness and clarity of the key key and type descriptions to the author is welcome.

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INTRODUCTION

Vegetation is the major resource land managers manage. It covers 99% of the land and is the source of timber, forage and cover for livestock and wildlife. It serves to hold the soil mantle in place protecting its own ability to survive besides keeping the soil from eroding into lakes and streams. It provides scenic backdrop and other visual qualities. It is easily manipulated and sensitive to natural catastrophes. Yet we know relatively little about it, its ecology or the ecological implications of its management.

What kinds of vegetation are there? Where do they occur? How sensitive are they? Are they equally suitable for deer or elk or sheep habitat? How do they respond to management treatment? How fast do they grow or regrow? Which plants or animals can be found where? The answers to these questions are tied up in the complex distribution patterns of plant communities and their interactions with the environment. In order to answer these questions in a way that will satisfy sophisticated managers as well as meet the considerable load of regulations imposed on land managers today, a system is needed which helps deal with the vegetational patterns, helps us understand the complex ecosystem interactions and provides a way to apply ecological knowledge for better management.

A beginning to the solution of these problems is the description of "kinds of vegetation" in a way that is both logical and natural and will help us communicate with each other about what we need and what we know.

Forest Cover Types and Range Sites have served partially to fill this need as have various vegetation or life-zone classifications. These are single-use classifications that fail to serve a wide need or are too broad to be of much use in land management. In fact, probably no single vegetation or ecosystem classification or description scheme will suffice by itself. We need a vegetation classification system that is internally compatible and meets the functional needs of managers.

The first step in addressing these questions is a classification and description of the potential vegetation of an area (Daubenmire and Daubenmire 1968; Hall 1970, 1973; Franklin and Dyrness 1973; Pfister et al. 1975). The potential (or projected climax) vegetation is in greatest equilibrium with its environment and is relatively stable. It is the most easily determined stage of successional development to which all other vegetation, regardless of stage or degree of disturbance can be (theoretically) related. It is the first step in trying to bring order to an otherwise bewildering mosaic of vegetation and vegetation-environment interactions. The basic unit of the potential vegetation is assumed to be the Plant Association.

STUDY AREA

The Cedar River and Green River drainages occupy the southern third of the North Bend Ranger District (Fig. 1). This area includes 180,000 acres (280 mi^2, 72,500 ha) of mixed ownership, of which 68,000 acres (28,000 ha, 38%) is Forest Service and is treated here separately from the rest of the North Bend District to the north and the ecologically similar White River Ranger District to the south. A geological-climatological break occurs near the north end of the Cedar River drainage that makes the recognition and presentation of this area ecologically as well as politically meaningful.

The western hemlock zone occupies about 67,000 acres (27,000 ha, 104 mi^2, 37%), although most of that is in non-Forest Service ownership. The silver fir zone occupies most of the rest of the watersheds (ca. 62%). While the mountain hemlock zone, including meadows and parklands, represents about 2% of the area.

The area is well roaded although many roads are gated, washed out or put to bed. Access is limited due to the restriction of municipal watersheds. Further complications arise through the checkerboard ownership pattern. Much of the non-Forest Service lands have been cut.

Climate is generally moist maritime. Winter storms blow in from the southwest across the southern Puget Lowlands and deposit 80-120 inches (200-300 cm) of precipitation on the average, most of which comes as snow or cold rain.

Bedrock is predominantly andesite. Some glacial evidence is noted at the higher elevations and in some of the major valleys.

Topography is mostly undulating and rolling foothills, with few slopes over 60%. elevation ranges from about 1500 feet (457 m) in the lower Cedar River to over 5700 feet (1744 m) at Pyramid Peak. Most elevations sampled ranged from 2000 feet (610 m) to 4500 feet (1372 m).

ECOLOGICAL PERSPECTIVE

Vegetation occurs over the landscape as a complex mosaic of various communities in different stages of development or disturbance and each responding to the gradients of environmental conditions (e.g., soil, climate, topography, temperature, etc.). Each community is the product of a different combination of environmental, biotic and historic factors.

Even if the effects of disturbance could be eliminated and all communities allowed to develop to the point where they are believed to be in equilibrium with the environment (climax?), the vegetation would still probably represent a continuum of communities when measured along a uniform environmental gradient over large distances. However, for any geographical area (in the western U.S. at least) environmental gradients are not uniform, and in fact marked discontinuities are common, with certain combinations of environmental factors occurring in the landscape more frequently than others. The segments of the vegetational continuum associated with those environmental "combinations" also occur more frequently. Therefore, although we recognize the continuum nature of vegetation, we analyze and portray it as natural segments or "types".

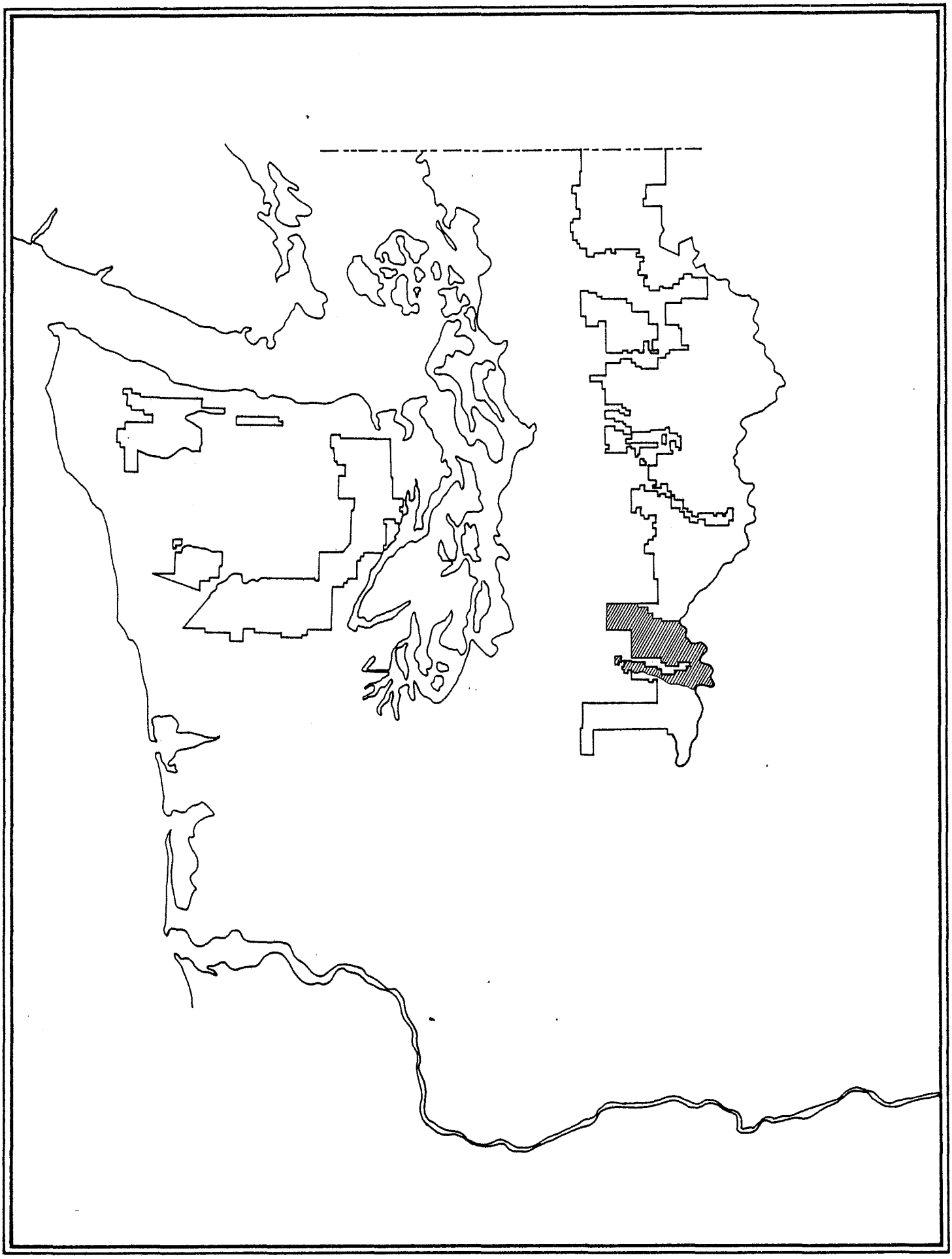


Figure 1. Map of Western Washington with the Study Area shaded.

CLASSIFICATION HIERARCHY

The classification hierarchy used in delineating and defining units of vegetation (potential and actual) and units of land with similar ecological characteristics is intended to be the same that is being proposed for national usage by the interagency Resources Evaluation Team (RET).

The classification hierarchy emphasizes potential vegetation at the level of the Plant Association as the basic unit. Plant Associations are abstract units of the potential vegetation which are characterized by the same overstory and understory dominants. Phases are finer subdivisions of the Association based on secondary or indicator species, and Series are aggregations of Associations with the same overstory dominants. Kuchler's Potential Vegetation Types (KPVT's) are equivalent to mapped series or groups of ecologically similar series. Regional formations (Biomes) are the next highest level above series in the currently proposed national classification.

The aggregate of all units of land capable of supporting a single plant association (at climax or stable-state) is called a Habitat Type. A Habitat Type is named for the Plant Association which characterizes it and may also have phases named for the Association phase.

Ecological Land Units (or Ecological Response Units) are areas of land with similar responses to treatment and reactions to the environment and are at least partially defined and delineated on the basis of the Habitat Type.

In addition to the potential vegetation types, it is also useful to recognize plant community types and plant communities. Plant communities are the actual entities which occupy the landscape. The plant community type is an abstract aggregation of similar communities which may or may not reflect their successional condition. However, a climax community type is considered synonymous with Plant Association. The classification hierarchy is outlined in Figure 2.

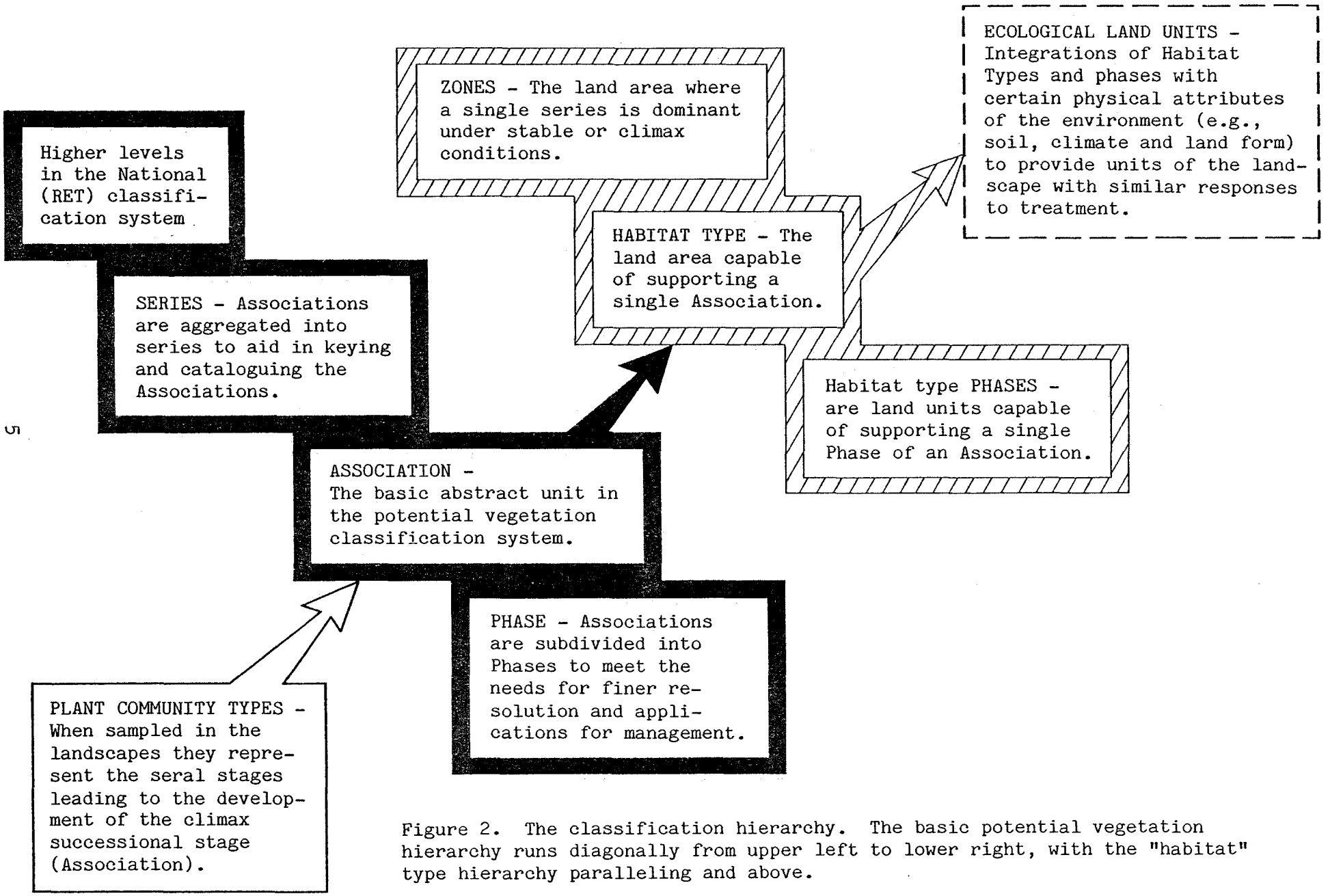

Higher levels in the National (RET) classification system
SERIES - Associations are aggregated into series to aid in keying and cataloguing the Associations.
ASSOCIATION - The basic abstract unit in the potential vegetation classification system.
PHASE - Associations are subdivided into Phases to meet the needs for finer resolution and applications for management.
PLANT COMMUNITY TYPES - When sampled in the landscapes they represent the seral stages leading to the development of the climax successional stage (Association).
ZONES - The land area where a single series is dominant under stable or climax conditions.
HABITAT TYPE - The land area capable of supporting a single Association.
Habitat type PHASES - are land units capable of supporting a single Phase of an Association.
ECOLOGICAL LAND UNITS - Integrations of Habitat Types and phases with certain physical attributes of the environment (e.g., soil, climate and land form) to provide units of the landscape with similar responses to treatment.

Figure 2. The classification hierarchy. The basic potential vegetation hierarchy runs diagonally from upper left to lower right, with the "habitat" type hierarchy paralleling and above.

FIRE HISTORY AND STATUS OF CURRENT VEGETATION

A preliminary stand age map is presented in Figure 3. From the basic stand age data represented in this map, a rough scenario of the fire history is known.

Few stands were encountered which could be called old old-growth and none that approached climax, owing to the long-term fire history (and perhaps to recent cutting). The oldest stands occur along the watershed between the Green and Cedar Rivers and in the very upper reaches of the Green River. These stands appear to have originated following a fire between 650 and 700 years ago and are tentatively dated at 663 b.p. (i.e. 1317 A.D.). A large area, covering much of T.21N., R.9E., is shown (Figure 3) in this age class. The actual extent of this old old-growth is less than is shown in the map, as the pattern is much more fingered, following stream course and north slopes more than is suggested by the map. Very possibly most of the Green and Cedar River drainages burned about this time. Most of the area currently in this age class occurs in the Silver fir (Abam) zone.

Another old old-growth stand occurs to the east of the 663 b.p. old-growth. It is tentatively dated at 451 b.p. (i.e. 1529 A.D.). Apparently about 1529 another large fire or series of fires burned much of the watersheds. Few older trees remain which could have recorded the fire. Such trees are most likely to be found along the boundary between the 663 and 451 year old stands. How much of the area actually burned at this time is also difficult to determine. However, judging from the fact that most of the 451 age class also lies in the silver fir zone; i.e., the cooler-wetter parts of the environment, the fire must have also claimed much of the drier and more fire susceptible areas adjacent to it.

After the burn, about 1529, over 100 years passed before another large fire is recorded in the vegetation. This fire occurred about 340 years b.p. Judging from the disjunct stands apparently all of this age class, a large fire consumed much of the Green River drainage at this time. It is possible that this fire occurred in the Cedar River as well, although no evidence for this is known. Shortly thereafter, another fire did burn much of the Upper Cedar River and the Upper Green River at about 276 b.p. (i.e. 1704 A.D.). Some stands in the Lower Cedar River and the Upper Green River appear to date from a smaller fire about 208 b.p. (1772 A.D.). Dates in this age class are suspect since few Douglas-fir were sampled.

Lastly, a well documented fire burned the upper Green River (and parts of the Greenwater and White River drainages) in 1899 (81 b.p.). The hotel at the Hot Springs near Lester burned down in this year during that fire. Also fire scars date a fire in this year. This was apparently a fire or series of fires caused by the railroad. About 30,000 acres (12,000 ha) burned in the Green River drainage along.

Complicating the understanding of this fire is the fact that fire scars were also recorded for fires about 109 and 71 years ago. Apparently a series of fires burned this area about 1899. The year 1902 was well documented as a severe fire year throughout western Washington and Oregon. The famous Yacolt burn occurred in this year. It is possible that part of this area also burned at that time.

Three major burning periods are recognized in the fire history of this area. These are the same periods that also show up in other areas. These burning periods are 250-370 years ago; 450-540 years ago and 650-700 years ago. Interestingly these three periods correspond to the three historic cold spells often referred to as the "Little Ice Age." The three phases of this little ice age now appear to correspond to minimum periods in the long-term sunspot cycle. The three corresponding sunspot minima are called the Maunder (1645-1715 A.D. or 265-335 b.p.), the Sporer (ca. 1420-1530 A.D. or 450-560 b.p.) and the Wolf (ca. 1280 to 1350 A.D. or 630-700 b.p.) (Stuiver and Quay 1980).

Why large fires should be more common during apparently colder climates is unclear. Perhaps as is believed by some, the summer and winter extremes were both greater than during that time, a period of great instability. Perhaps the overall weather patterns changed, giving the area greater frequency of dry east winds. If the relationship holds under further validation, we may gain some comfort by knowing that we are in a period of high sunspot numbers and may thus be relatively safe from the kind of fire that has apparently devastated much of the area many times in the past 700 years.

SAMPLING PROCEDURES AND ANALYSIS

The vegetation was sampled using 500 m^2 reconnaissance plots. These plots were used to acquire data on vascular plant species presence and cover. The taxonomic authority used was Hitchcock et al. (1955-69). Hitchcock and Cronquist (1973) was used for field identification. Data were also taken on the physical site features (slope, aspect, elevation, and topography) plus measures of stand structure, age and productivity. Plot locations were marked on air photos and topographic maps. Details of plot layout, coverage estimates and parameter codes are not presented here, but are available on request. In general, they follow the procedures used by Henderson 1974, Henderson et al. 1979, Franklin et al. 1979, and discussed in Franklin et al. 1970, and Henderson 1979.

Sampling was done to provide an adequate coverage of all areas, stand ages and vegetation types at an intensity of at least one plot per section of land (Figure 4). To do this, several sampling strategies were used. Initially, we tried to put one plot near the center of each section of land where road or trail access allowed. Since sampling of old-growth communities was the primary objective, often the most accessible stand of old-growth near the center of a section was used.

Where this sampling scheme was not feasible, road, trail or cross-country transects were used with a predetermined sampling interval (e.g., each 1/2 mile, 1/2 hour, or 300 feet elevation). Lastly, if this did not prove appropriate for the vegetation at hand, subjective bias was used to allow sampling of communities too small or irregular to be picked up in the other strategies. Also, plots were often established in clusters (most often as pairs) when it would be useful for subsequent analysis to show, for example, the vegetation on two or more contrasting aspects or to sample two or more different age classes contiguous or near enough to each other to represent the same kind of site.

The resulting sample of 101 plots in the Green and Cedar River drainages represents a combination of systematic and subjective sampling strategies. The objective was to ensure optimum representation in the samples of the variability in vegetation in the District. This provided us with a sampling intensity of 1.0 plots/section in the Green and Cedar River drainages.

Identification of plant Associations used computer assisted sorting and clustering routines. Only old-growth and climax communities were used in this analysis. Association and similarity tables and cluster analysis dendrograms were generated to help group climax communities and projected climax communities into types. Each type being comprised of and characterized by communities with relatively homogeneous composition. Although several different approaches are used, and each one aggregates plots into clusters or types, they ordinarily do not completely agree. The final marrying of approaches becomes subjective and controlled largely by the biases and perspectives of the classifier. However, the objective is a classification of climax community types (Associations) with the greatest overall within class similarity and the greatest between type dissimilarity.

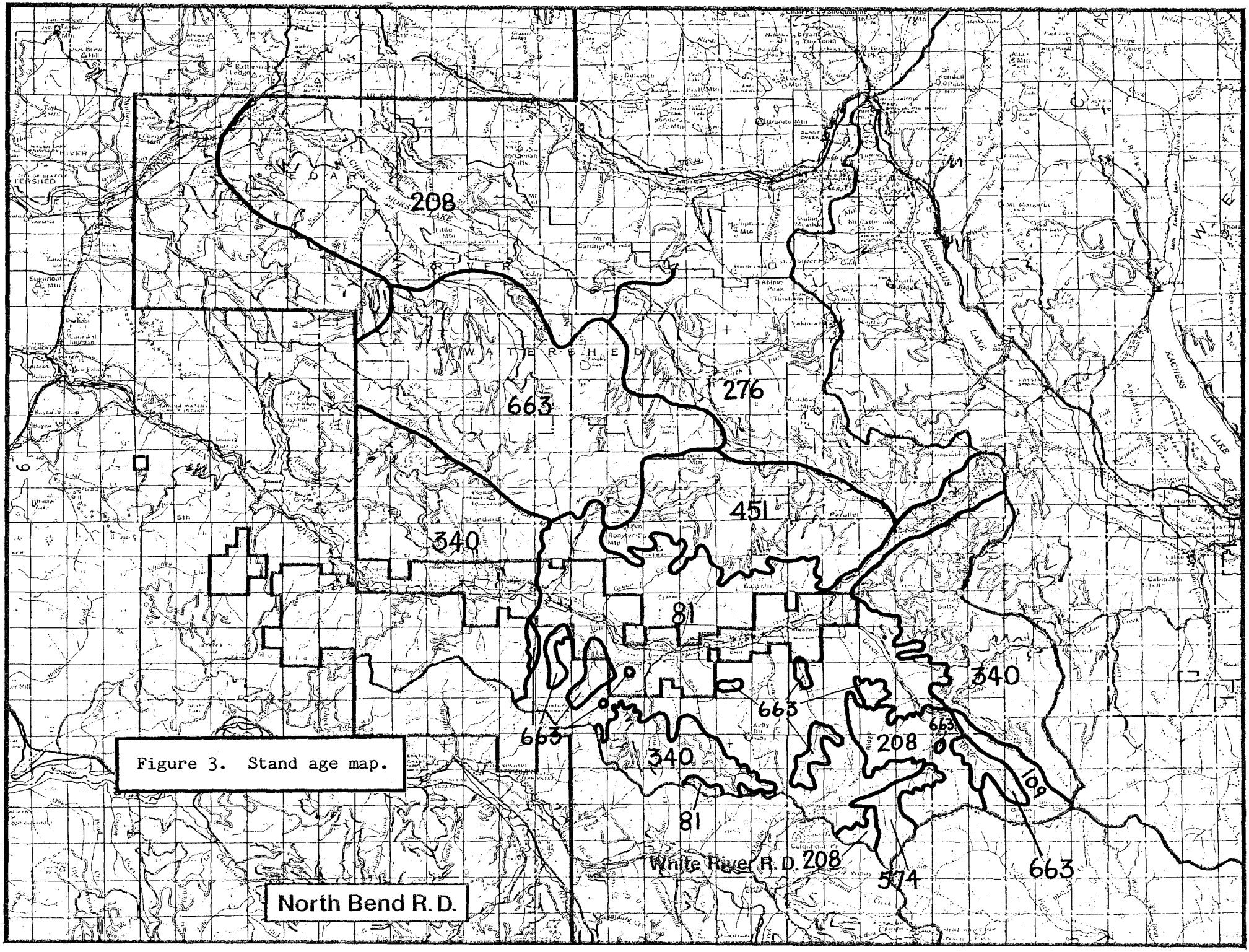
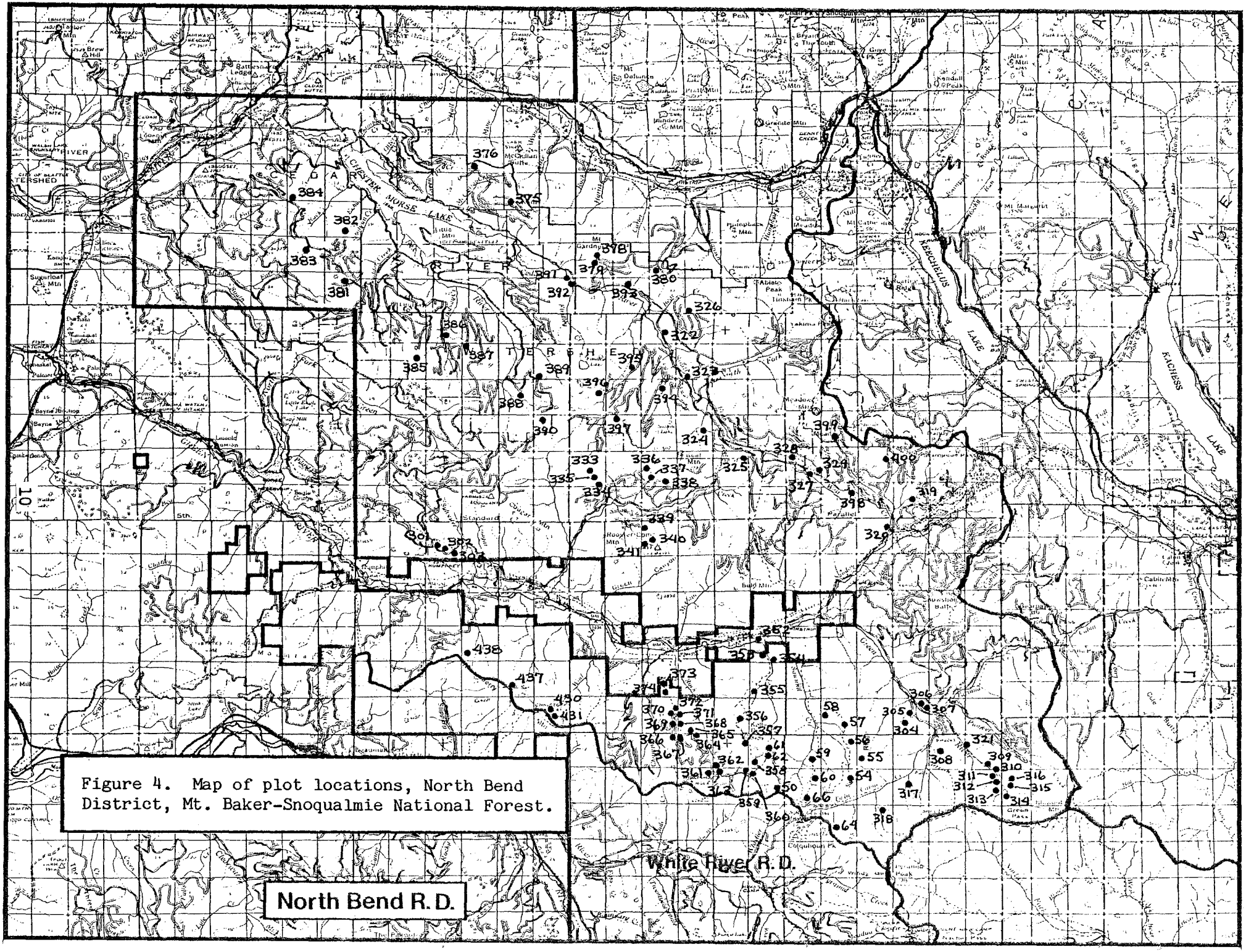


Figure 3. Stand age map.


North Bend R.D.
White River R.D.
Figure 4. Map of plot locations, North Bend District, Mt. Baker-Snoqualmie National Forest.

THE FOREST SERIES

Three Forest Series are represented in this area - the Tsuga mertensiana (Tsme), Abies amabilis (Abam), and Tsuga heterophylla (Tshe) Series. The Abam Series is best represented with the Abam zone occupying about 62% of the area, with the Tshe zone occurring on most of the remainder.

The approximate relationship between aspect and elevation for these zones is shown in Figure 5. Using this relationship and the sample plot locations as verifications a rough map of the vegetation zones was made (Fig. 6). This is a first approximation, the intent is to field check this map and verify or modify during the next phase of sampling.

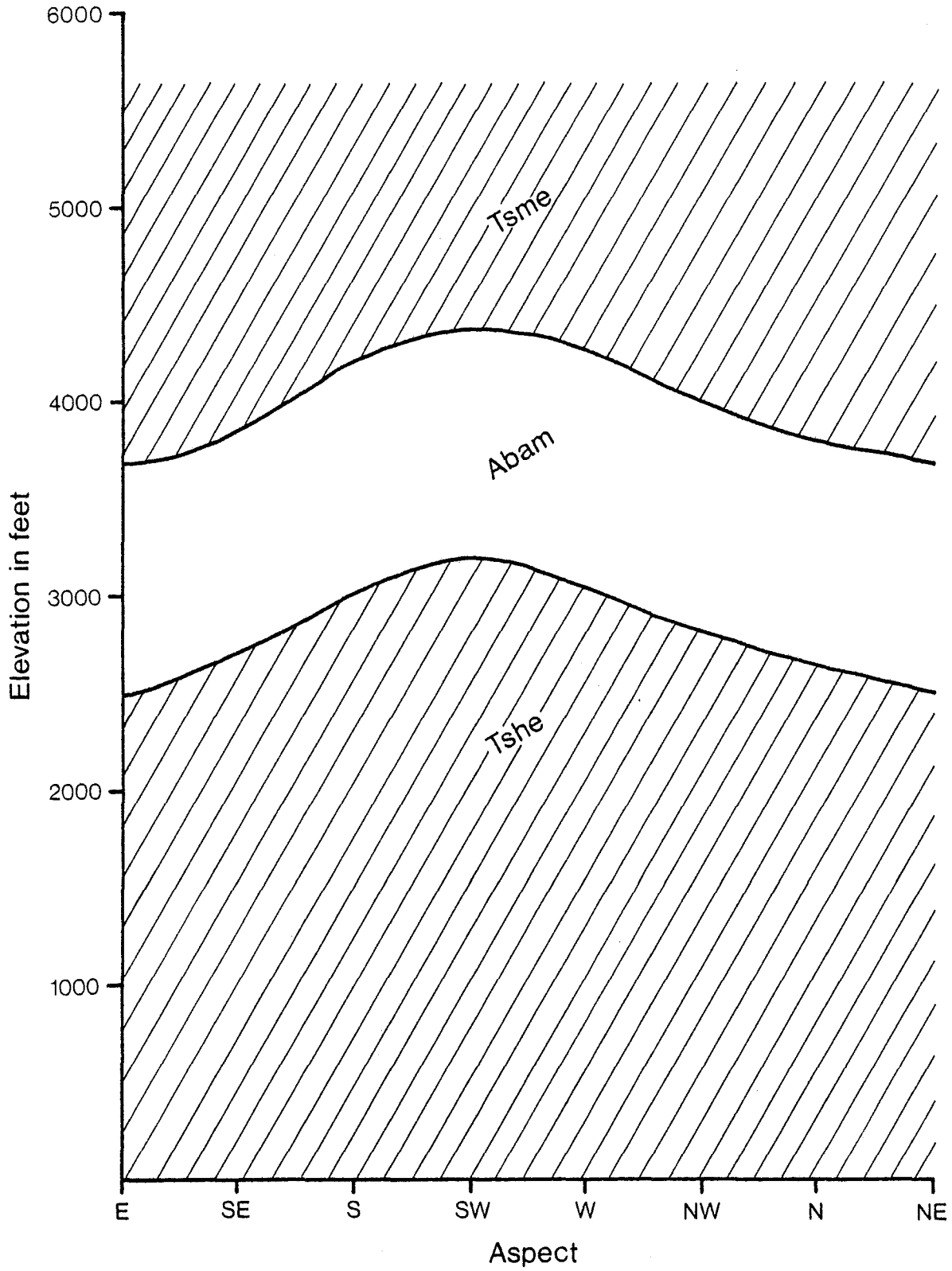


Figure 5. Elevation - Aspect relations for major Series (Zones), Green and Cedar River drainages, North Bend Ranger District.

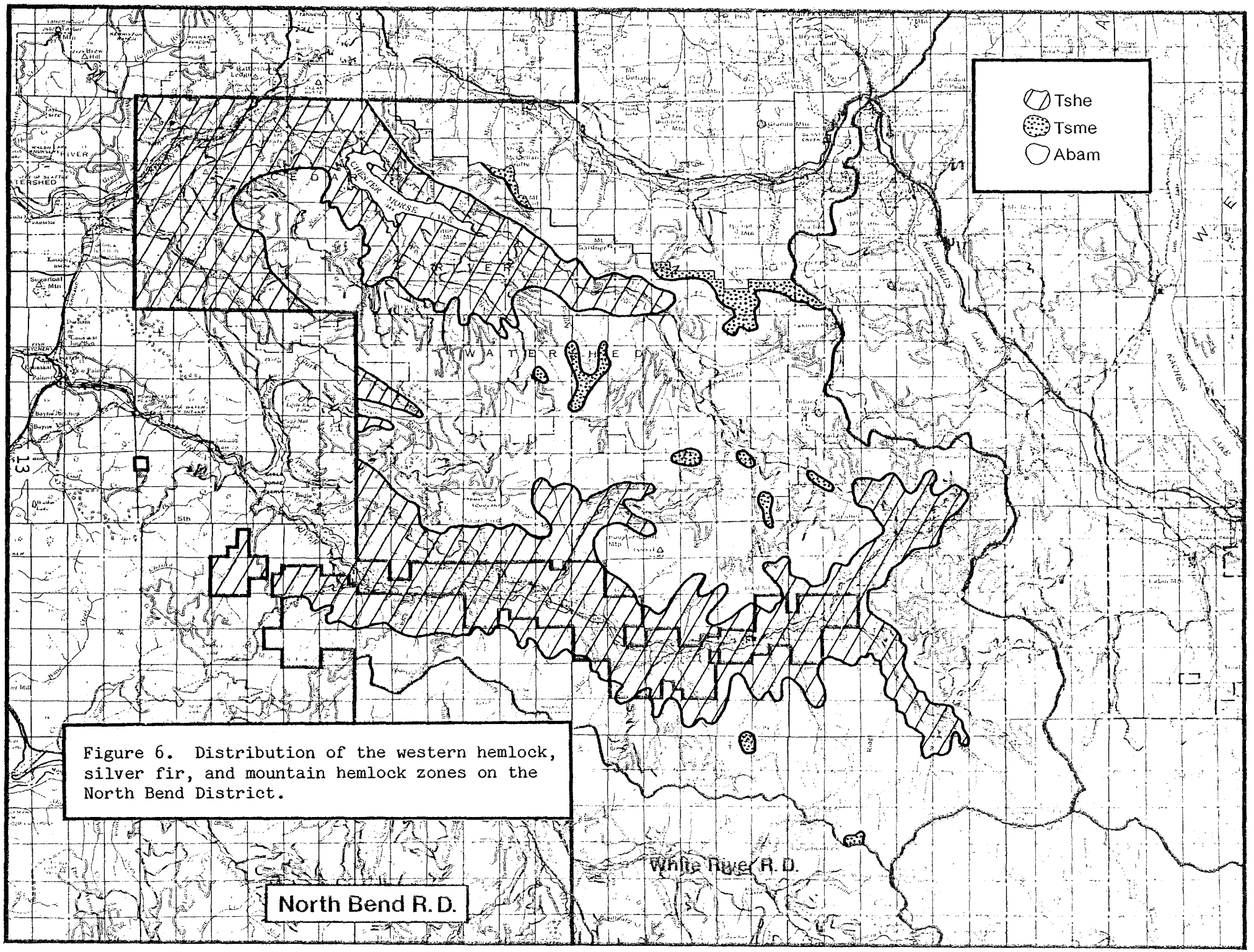


Figure 6. Distribution of the western hemlock, silver fir, and mountain hemlock zones on the North Bend District.

Key to the Forest Series[1]

1. Mountain hemlock ≥ 10% cover . . . . . Tsme[2] Series p. 15

1. Mountain hemlock < 10% cover or seral. . . (2)

    2. Silver fir ≥ 10% cover . . . . . Abam Series p. 21

    2. Silver fir < 10% cover
    and Western hemlock ≥ 10% cover. . . . . Tshe Series p. 35

[1] This key applies only to communities in the projected climax condition. Therefore, only tree species able to compete in the climax condition are used. When a species can be seral on one site and climax on another, care should be taken to recognize the proper successional character of the species.

[2] These abbreviations include: Tsme = Tsuga mertensiana (mountain hemlock); Abam = Abies amabilis (silver fir); Tshe = Tsuga heterophylla (western hemlock).

Mountain Hemlock (Tsuga mertensiana, Tsme) Series

The mountain hemlock series is found sporadically at the highest elevations or in cold pockets at somewhat lower elevations in the study area. Four old-growth stands were sampled in this area that belong to the Tsme Series. About 40 additional plots were taken on comparable sites either to the north or south which represent either a Tsme[1] or Abla climax. The Tsme zone (that area where Tsme Series is dominant) is generally recognized above 4500 ft. (1370 m). In the Green-Cedar River area (Fig. 6) it occurs in cold pockets down to 3300 ft. (1000 m). The Tsme zone occupies ca. 3000 acres (1200 ha) or some 2% of the area. The Tsme Series in its typical form is essentially absent in the Greenwater River area to the south, being replaced by the Abla Series which begins about 5500 ft. (1675 m). Stable or climax non-forest Associations in the Tsme zone belong to the Parkland subzone and are not covered in this preliminary draft.

The Tsme zone characterized by high precipitation and cold maritime temperatures which result in a deep and long-lasting winter snowpack. Precipitation generally exceeds 100 inches (254 cm) (Table I) in this zone and falls mostly as snow or cold rain during the winter season. Because of this precipitation pattern, moisture is generally amply available, except on extreme topoedaphic situations where excess drainage may occur. Water is sometimes limiting in the excess where topographic features allow soil water to accumulate (bogs, springs, stream channels).

The temperature regime here is probably a more significant environmental factor than the moisture pattern, except perhaps for the physical forces of the heavy snowpack itself. Cold soils due to the lower ambient air temperature and the depth and lateness of the snowpack probably precludes many lower elevation species here. Summer soil temperatures at a depth of about 20 cm (8") seldom get above 12°C (54°F). This upper zone of the soil is maintained at near-freezing temperatures by the insulating effects of the snowpack throughout the winter, and warm very little until the snowpack is gone. Then there is a rise in soil rooting zone temperatures until cool rains resume in the fall. This short period of time of soil warming is a significant ecological factor in the Tsme zone. In addition to the cold soil temperatures in the rooting zone, the effect is compounded by the occasional high soil surface temperatures on unshaded and darkened surfaces. This contrast in soil temperature within only a few centimeters is a very harsh environment for plants to germinate and become established.

Soils are variable, but generally typical of high mountainous areas. They are mostly developed from steep, shallow and unstable colluvium or remnants of alpine glacial till. Many of the stands sampled with mature Tsme occurred on the granite bedrock material near Bearhead Mountain. This may not be an accident since the Tsme zone becomes more abundant on granite farther north.

[1]In the case of Tsme climax, the Tsme Series is usually recognized when Tsme is at least co-climax with Abam, Chno or Abla, and Tshe is absent or of lesser importance than Tshe.

Due to the short growing season and cold temperatures, timber stand growth and tree re-establishment (succession) following disturbance, are generally quite slow. The mean tree height (based on silver fir or mountain hemlock) expected at age 100 years was calculated to be 72.5 ft. (22 m) and a range from 58 to 85 feet. This is based on tree age, however, and not total stand age. Since there is often a long establishment period following disturbance of 30 to 150 years in this zone, and often very suppressed height growth in the early years, this may represent a substantial overestimate of what might be achieved starting from the time of disturbance. Basal area for these same stands (174-532 years estimated ages) average 242 $ft.^2$/ac. (56 m^2/ha) with a range from 180-270 $ft.^2$/ac. (41 - 62 m^2/ha).

Two Tsme Associations are identified based on sampling. Two additional Associations are listed and included in the key and are likely to be found, but were sampled only outside the area.

Key to the Associations in the Tsuga mertensiana Series

1. White rhododendron (Rhal) ≥ 5% cover . . . . . Tsme/Rhal[1]

1. Rhal < 5% . . . . . (2)

    2. Alaska huckleberry (Vaal) ≥ 10% cover . . . . . Tsme/Vaal p. 19

    2. Vaal . . . . . (3)

        3. Thinleaved huckleberry (Vame) ≥ 10% cover . . . Tsme/Vame[1]

        3. Vame < 10% . . . . . (4)

            4. Beargrass (Xete) ≥ 10% . . . . . Tsme/Xete p. 20

            4. Not as above, either 1) Depauperate understory (often due to dense overstory). Return to lead 1 and use relative cover instead of absolute cover; or select a new plot location with a more normal overstory stocking; or 2) community sampled is not in stable or near-climax condition. Estimate the projected climax condition and return to lead 1; or 3) community does not properly belong to the Tsme series; or 4) unrecognized or an unclassified Association for this area.

[1] Association not sampled in this area but to be expected.

Table I. Weather Stations in the Mountain Hemlock Zone.

		TEMPERATURE			PRECIPITATION	
STATION	ELEVATION	AVE. ANNUAL	AVE. JANUARY	AVE. JULY	AVE. AMOUNT	SNOWFALL
Stevens Pass	4085' (1245 m)	39.3°F. (4.1°C.)	23.4°F. (-4.8°C.)	56.3°F. (13.5°C.)	75.55" (1919 mm)	
Snoqualmie Pass	3020' (920 m)	41.8°F. (5.5°C.)	26.3°F. (-3.2°C.)	57.8°F. (14.4°C.)	107.6" (2733 mm)	387" (982 cm)
Mount Baker Lodge	4469' (1362 m)	40.1°F. (4.5°C.)	27.3°F. (-2.6°C.)	53.8°F. (12.1°C.)	111.1" (2821 mm)	550" (1398 cm)
Paradise Ranger Station	5975' (1821 m)	38.1°F. (3.4°C.)	25.9°F. (-3.4°C.)	52.9°F. (11.6°C.)	103.7" (2635 mm)	536" (1362 cm)
Stampede Pass	3978' (1206 m)	39.9°F. (4.4°C.)	23.7°F. (-4.6°C.)	56.9°F. (13.8°C.)	93.60" (2377 mm)	

1 These stations are near the mountain hemlock zone, but in the silver fir zone. They are included for reference.

Tsuga mertensiana/Vaccinium alaskaense (Mountain hemlock/Alaska huckleberry, Tsme/Vaal) Association.

Three plots were sampled in the Cedar River drainage which form the basis for recognizing this Association. Mountain hemlock trees in these plots were determined to be 174, 225 and 532 years old. The ages of these communities, however, is expected to be 40-150 years older. The elevation range was 3300-3940 ft. (1006-1200 m) i.e. relatively low for the Tsme zone in this area. The presence of Vaal indicates a close relationship to the common Abam/Vaal type at slightly lower elevations. These sites too apparently represent some micro-topographic situation which creates a frost pocket or cold air drainage. Site index values based on measured tree ages (rather than community age) averaged 67 ft. (20.5 m) at 100 years. Average basal area was 230 $ft.^2/ac$. No consistent relationship to soil factors could be determined by comparing the plot locations to the Soil Resource Inventory (SRI). Crown cover of the overstory canopy averaged 55% while the understory layer averaged 92%.

Vaccinium alaskaense (Vaal) was clearly dominant in these three communities averaging 55% cover. Vaccinium membranaceum (Vame), Rhododendron albiflorum (Rhal) and Xerophyllum tenax (Xete) were also conspicuous in at least one of the plots sampled. Forbs were conspicuously low in coverage.

Because of the harsh environment in the Tsme/Vaal h.t. silvicultural options are severely limited. Regeneration probably could reasonably only be obtained with 5 years by saving and cultivating advanced (Abam) regeneration. Following clearcut and burn or wildfire, it is reasonable to expect the seral shrub dominated stages to persist for about 100 years before "canopy closure" (i.e. relative to this site). Huckleberries (Vaal and Vame) will dominate these early stages and often bear profusely enhancing somewhat the recreation opportunities and wildlife forage.

This type is similar to the widespread Abam/Vaal type recognized by many authors in Western Washington and Oregon.

Tsuga mertensiana/*Xerophyllum tenax* (Mountain hemlock/Beargrass, Tsme/Xete) Association

Only one stand was sampled which is recognized as representing the Tsme/Xete Association. It occurred in the Cedar River drainage at 3920 ft. (1195 m) on a moderately steep westerly exposure on a relatively dry topographic position. Little can be said about characterizing an Association based on one plot except to recognize its presence in an area. This type is recognized as the Abam-Tsme/Xete community type in the Cedar River drainage by Del Moral and Long (1977) and as the "Tsuga" community type for the Findley Lake Basin by Del Moral (1973).

Management and productivity relations of this type are expected to be comparable, though perhaps a little more extreme, than the Abam/Xete type at slightly lower elevations.

Abies amabilis Series

Classification and description of the Association in the Abam series is based on 33 old growth and climax plots. Four Associations are recognized for this area based on these plots. By far the dominant Abam type is Abies amabilis/Vaccinium alaskaense represented by 21 of the 33 plots. Abam/Berberis nervosa was represented by eight plots and Abam/Vaccinium membranaceum and Abam/Oplopanax horridum by two each.

These associations develop under a climate that is cool and moist with precipitation exceeding 100 inches (254 cm) and occurring most as snow (Table II). One of the most pronounced characteristics of the Abam zone is the presence (in normal years) of a persistent winter snowpack. Generally, there is a snowpack on the ground from November to March at its lower limits and from November to June at higher elevations. The snow is not merely a continuous snow cover. It is an accumulation of numerous snowfalls forming a layered and compacted deposit. Although there is a gradual and continuous lowering of temperature with increasing elevation the enviromental discontinuity occurring at the intergrade between the western hemlock zone and the silver fir zone is significant. There are two major impacts that this discontinuity can have on the vegetation. One, the presence of a dense snowpack makes the snowpack melt significantly later in the spring than nearby areas. The result is a later discharge of cold water into the soil, delaying the warming of the soil profile and delaying and shortening the summer drought. The second is that the weight of the snowpack itself can have a direct effect on the plants.

Certain plants appear to be sensitive to the compaction and breakage effects of a snowpack. Alnus rubra, Gaultheria shallon, Acer circinatum, and Polystichum munitum are believed to be sensitive to the weight of the snowpack.

Timber productivity relationships in the silver fir zone could be described as moderate to low.

This series typically does not provide either good ungulate winter or summer range although recent burns or clearcuts can yield a flush of spring and summer forbs. Mountain goats may winter here, however, and many sensitive old-growth species are found here since much of the remaining old-growth is in the silver fir zone and the lower frequency of historic fires has yielded older, more successionally mature communities than are typically found in other zones. Many animals use the huckleberries as food in this zone. The average age of 33 "old-growth" stands in this series was 402 years. While the western hemlock series averaged 330 years for 9 stands and mountain hemlock series averaged 290 from four stands. The age of high elevation mountain hemlock stands is usually underestimated due to slow growth and slow early succession.

Key to Associations in Abies amabilis (Silver fir, Abam) Series

1. Devil's Club (Opho) ≥ 5% cover . . . . . Abam/Opho p. 26

1. Opho < 5% . . . . . (2)

    2. Alaska huckleberry (Vaal) ≥ 10% . . . . . Abam/Vaal p. 27

    2. Not as above . . . . . (3)

        3. Oregongrape (Bene) ≥ 10% or Bene and Gash combined ≥ 15% . . . . . Abam/Bene p. 31

        3. Not as above . . . . . (4)

            4. Thinleaved huckleberry (Vame) ≥ 10% . . . Abam/Vame p. 33

            4. Not as above, either a depauperate community (return to lead 1 and use relative cover instead of absolute cover) or community sampled in disturbed or seral condition or undescribed Association for this area.

Table II. Weather Stations in the Silver Fir Zone

Station	Elevation	Temperature			Precipitation	
		Ave. Annual	Ave. January	Ave. July	Ave. Total	Snowfall
Snoqualmie Pass	3020' (920m)	41.8°F (5.5°C)	26.3°F (-3.2°C)	57.8°F (14.4°C)	107.6" (273.3 cm)	387" (982 cm)
Stampede Pass	3958' (1206m)	39.9°F (4.4°C)	23.7°F (-4.6°C)	56.9°F (13.8°C)	93.6" (237.7 cm)	
Spirit Lake	(1063m)	(5.6°C)	(-2.0°C)	(14.9°C)	(225.3 cm)	(718 cm)

Table III. Environmental Features Table for *Abies amabilis* Associations

	Abam/Vaal (21)	Abam/Bene (8)	Abam/Opho (2)	Abam/Vame (2)
Elevation	3279±43[2]	3852±104	3380	4360
Aspect	N	SE	E	SW
Slope	37±20	53±13	27	35
Top height (m)	49.0±9.9	42.9±5.4	47.0	33.0
Top height (ft.)	161±32	141±18	154	108
BA ($ft.^2/ac.$)	277±79	304±57	195	210
Site index[1] (Douglas-fir)	105			

[1] Based on Curtis et al. (1973) curves, represents dominant tree height in feet at 100 years.

[2] Means ± one standard deviation, when sufficient sample size.

Table IV. Constancy/Coverage Table for Abies amabilis Associations

Species	Abam/Vaal (21)	Abam/Bene (8)	Abam/Opho (2)	Abam/Vame (2)
PIMO	.			5(4)
THPL	4(4)	8(10)		
PSMEM	6(11)	9(13)		
TSHE	10(48)	10(62)	10(38)	10(25)
ABAM	10(50)	10(41)	10(56)	10(37)
ABPR	1(1)	.		5(34)
TABR	1(1)	8(5)		
TSME	.	.		
CHNO				
ABLA2		.		
VAPA	4(1)	9(2)	5(1)	5(1)
ACCI	2(3)	5(3)		
GASH	.	5(4)		
BENE	2(1)	10(18)		
VAAL	10(31)	10(4)	10(3)	5(4)
VAOV	3(6)	1(1)	10(2)	
OPHO	2(1)		10(38)	
RUSP	.		10(2)	
VAME	4(1)	6(1)	5(2)	10(20)
PAMY	.	5(1)		
MEFE	5(1)	.	10(1)	10(8)
RHAL	2(1)	.		
LIBO2	6(4)	10(4)		
XETE	2(1)	5(1)		10(4)
COCA	8(5)	10(3)	5(2)	
CLUN	10(5)	6(1)	10(2)	5(1)
PYSE	4(1)	.		5(2)
TIUN	.		10(1)	
TITR	.		5(1)	
LYCL	1(1)			
ACTR	3(1)	.	5(4)	
BLSP	5(2)			
ATFI	.		10(6)	
GYDR	.		5(8)	
STRO	4(1)		10(1)	
SMST	2(1)	.	10(1)	5(1)
CHUM	.	9(1)		.
TROV2	.	.		
GOOB	.	.		
VISE	.	.		
CHME	.	6(1)	5(1)	
RULA	5(1)	.	10(1)	10(8)
RUPE	8(1)	.	10(2)	5(4)
LICO3	.	.		
RUUR	.	.		
TRLA2	.	.		
POMUM		.		
COME	.	8(1)		
LULA	.			5(1)

[1]First value is constancy, where 2 = 20%, 3 = 30%, 4 = 40%, etc. and the second value ( ) is mean coverage for all plots in the type where 1 = .5 - 1.5% cover and + is < .5%.

Abies amabilis/Oplopanax horridum (Silver fir/Devil's Club, Abam/Opho) Association

Two old-growth stands were sampled which have been assigned to this type (Table II). Such a limited sampling does not provide sufficient data to adequately describe a type for an area. Both plots were in the Cedar River drainage in the general vicinity of Findley Lake. Site index values are above average for the silver fir zone, but tree basal area is below average.

Both phases recognized by Franklin et al. (1979) are represented in this sample. Abam/Opho (Valley) is represented by plot 2394 in Sutton Creek and Abam/Opho (slope) is represented by plot 2385 near the headwaters of Lindsey Creek.

Abam and Tshe codominate the tree layers. In the understory numerous wet site species are present besides Opho. They include Rubus spectabilis, Vaccinium alaskaense, V. ovalifolium, Athyrium filix-femina, Gymnocarpium dryopteris, Streptopus roseus, Tiarella unifoliata, Rubus pedatus and Clintonia uniflora (Table III).

This type is similar to the Opho phase of the Abam/Vaal type.

Abies amabilis/Vaccinium alaskaense (Silver fir/Alaska huckleberry, Abam/Vaal) Association

The Abies Amabilis/Vaccinium alaskaense Association is the most common component of the old-growth vegetation in the Green and Cedar River drainages. Its landscape counterpart, the Abam/Vaal habitat type, is the commonest component of the land, accounting for about 40% of the total area. This is not atypical for the Mt. Baker-Snoqualmie National Forest as it is possibly the commonest habitat type throughout this area.

The Abam/Vaal Association in its mature (i.e. climax state) is codominated by Abies amabilis and Tsuga heterphylla in the tree layers (Table IV). Vaccinium alaskaense is typically the dominant species in the ground layers. Vaccinium ovalifolium, Berberis nervosa, V. membranaceum, Acer circinatum, Linnaea borealis, Cornus canadensis, Clintonia uniflora, Blechnum spicant, Streptopus roseus, Rubus lasiococcus, Rubus pedatus and Xerophyllum tenax are commonly encountered in at least some phases of this association.

Thuja plicata is often a minor component of the tree layer. This species reproduces very slowly and infrequently throughout much of its range. It maintains itself here by virtue of its tolerance to shade and longevity. Chamaecyparis nootkatensis and Tsuga mertensiana are sometimes encountered in minor amounts in the cooler, wetter portions of this type. Pseudotsuga menziesii is at least condominant in the tree layer for the first 100 years of some phases but yields to Abies and Tsuga after about 200 years. Because of the longevity of the species, however, individuals will persist in the stand for at least 700 years, and perhaps for as long as 1100 years in some areas, although when graphed, the extinction curve seems to indicate that it will be gone at about 850 years. It would therefore take about that long for the mature (climax) Association to develop.

The Association indicator, Vaccinium alaskaense, appears to dominate the site within the first 10 years of succession, although this is an average for the type and may take less time under a light or no burn condition, or longer with a more severe ground fire or broadcast burn.

The number of sampled stands in the 400-700+ year age class reemphasizes the belief that the natural fire history in the Abam/Vaal h.t. is one of fewer, probably more severe fires throughout recent history (last 2000 years). These sites being cool and well-watered, are believed to be less able to carry wildfire. This should be considered when looking for natural fire breaks. Likewise, slash disposal by burning might be considered less critical here than in other types.

Timber productivity is moderate to low. Data from Olympic National Forest inventory plots for old-growth stands on this habitat type contain 7333 ft^3/ac. (40,000 bd. ft./ac.). Yield capability tables from McArdle and Meyer (1930) however indicate that for pure Douglas-fir stands at lower elevations about 10,000 ft^3/ac. is attainable in about 160 years (for SI 105 and BA 277 ft^2/ac.). Maximum net volume probably occurs about 400

years and culmination of mean annual increment (from Curtis et al. 1973) is around 150 years. Yield at culmination of MAI is probably about 10,000 ft^3 although better yield data are badly needed for middle and upper elevation mixed stands.

Site index was estimated using McArdle and Meyer's (1930) curves for low elevations and Curtis et al. (1973) curves for middle elevations. In addition, a mean top height curve was generated from 35 plots from 7 to 660 years old. The shape of the mean top height curve closely resembled that of Curtis et al. (1973), suggesting that they represent a more appropriate site index scheme for this type than McArdle and Meyer's (1930). Average site index using McArdle and Meyer's (1930) curves for 11 old-growth stands (with Douglas-fir in them to use as site trees) was 131.5 (base 100). In addition, 7 stands under 150 years averaged 107.3. (It would be expected that site index estimate of stands near 100 years old would be more accurate than those either older or younger.) Using Curtis et al. (1973) an average site index for the same 11 old-growth stands was 104.6. The mean top height curve based on a hand-fit curve using 30 data points intercepted 100 years at 100 feet. A mean dominant tree height of about 100 feet at 100 years is a reasonable expectation for the Abam/Vaal h.t. Although that may seem low, the height growth continues on for some time not leveling off for several centuries. Basal area appears to peak at about 280 ft^2/ac. by about 300 years.

Silvicultural opportunities exist in the use (or non-use) of fire, in species selection and the use of known seed source. Stocking level may be manipulated somewhat, but probably not to much advantage. Species selection through improvement cutting or cleaning might also enhance yield or quality, but on these sites, this too seems unlikely to give significant positive results.

Yield tables and other yield data are conspicuously lacking for this major type. This makes management decisions more difficult.

One option should be considered when harvesting stands on this type. Full utilization plus yarding of unmerchantable material, light or no burning and reliance on natural (including young advanced) regeneration. This has already been practiced on some areas, with good results. A mixed stand of hemlock and fir with some Douglas-fir and/or noble fir will probably give greatest yields. The favored species (hemlock and fir) are shade tolerant and can regenerate or release successfully under moderate shade. Douglas-fir and noble fir may be able to seed in on scarified areas or be planted to generate the optimum species mix.

The use of the residual forest edge can enhance species composition, growth rates and decrease the lag from cutting to establishment. Wagner (1980) showed that for an unburned clearcut density of (natural) seedlings decreased away from the forest edge. Silver fir was more common near the forest edge while hemlock increased in growth rate and abundance away from it, outgrowing silver fir in the open. Establishment of all species was 5-10 years earlier near the Forest edge.

Wildlife considerations are minor in the Abam/Vaal Association and only slightly higher throughout the various stages of development on the Abam/Vaal h.t. An occasional sign of big game can be seen, mostly in the Opho and Bene phases. Northern spotted owl is found here, mainly, I suspect, because much of the remaining old growth on the Forest is in this type.

Phases of Abam/Vaal

Four phases of this type are recognized for this area. Abam/Vaal (-Bene phase) represents the warmer and drier portion of this type. It occurs generally between 3000 and 3700 feet (900-1100 m) elevation on southerly aspects or dry micro positions Berberis nervosa and other Gash union species are often present, such as Gaultheria shallon (usually on mounds, raised logs, or around the bases of trees or on stumps, Vaccinium parvifolium and Acer circinatum. Linnaea borealis is usually present and Xerophyllum tenax shows up on the driest sites. Productivity is slightly less than for the type as a whole, but Douglas-fir is more common here. The Vaccinium ovalifolium (-Vaov) phase occurs at the moister end of the scale for this type being generally found near or in stream bottoms and along toe slopes, where the soil is well watered from above. The elevation of this phase is a little lower than the average for the type. Productivity, as indicated by site index is a little higher than average. Douglas-fir is also a common component of this phase up to about 800 years indicating its suitability to these sites. The Oplopanax horridum (-Opho) phase represents an even moister site than the Vaov phase but in similar topographic positions. Douglas-fir occured in both old-growth plots sampled in this type and the average site index was highest of any phase in the Abam/Vaal Association. Rubus spectabilis, Gymnocarpium dryopteris (oak fern) and Tiarella unifoliata and trifoliata are common associates of Opho here. The typical phase Abam/Vaal (-Vaal) was represented by about 40% of the plots taken. Usually Vaal is the single dominant understory plant. Cornus canadensis, Clintonia uniflora, Rubus pedatus and Blechnum spicant are common but rarely dominant associates. Site index is generally lower than the other phases as this phase represents the cooler range of the type.

Key to the phases of Abam/Vaal:

1. Opho $\geq$ 3% . . . . . - Opho phase

1. Opho $<$ 3% . . . . . (2)

    2. Vaov $\geq$ 10% . . . . . - Vaov phase

    2. Vaov $<$ 10% . . . . . (3)

        3. Bene $\geq$ 3% or Bene present with Acci, Vapa or Gash also usually present . . . - Bene phase

        3. Community otherwise[1] . . . . . - Vaal phase

[1] The dry phase (-Xete) may occur in this area. It would be represented by at least 10% cover of Xete without Opho or Vaov. Bene may be present.

Abies amabilis/Berberis nervosa (Silver fir/Oregongrape, Abam/Bene) Association

Eight old-growth plots averaging 447 years old plus two seral plots 80-105 years old were sampled on the Abam/Bene h.t., mostly in the Green River drainage. These plots ranged from 2200 to 3780 feet (670-1150 m) but occurred mainly about 3200 feet (915 m). These sites are generally dry for this elevation, with the plots occurring on southerly aspects or otherwise warm or dry microsites. The association description is based on these eight old-growth plots. The projected climax condition includes about equal amounts of Tshe and Abam, small amounts of both Tabr and Thpl, about 25% cover of Bene and 5% Vaal in the understory (Table IV), plus small amounts of Coca, Chum, Clun, Chme, Xete, Libo2, Vame, Vapa, and Come.

Although Douglas-fir plays a more dominant role in the early (first 200 years) succession on this habitat type, the productivity as indicated by Douglas-fir site index (Curtis et al. 1973) is low (site V), averaging only 94 feet (28.7 m) tall at 100 years. Basal area plateaus at above 290 $ft.^2/ac.$ (67 m^2/ha) at about 200 years (Table III).

Ecologically this type represents the low elevation, dry segment of the Abam series. It is closely related to the Tshe/Bene and Abam/Vaal-Bene types occurring often as a transition from hemlock dominance below to silver fir/Vaal above. It is environmentally very difficult to separate from Abam/Gash, which is known to occur just to the south of this area.

Silviculturally, this can represent a tricky situation. Douglas-fir and hemlock, using either naturals or carefully selected ecotypes, are probably the best species to cultivate here. Noble fir may also do well as might white pine, although the sampled stands showed almost none of these under natural conditions. It may be a little too dry to get much silver fir by 200 years. Culmination of MAI is expected to occur at about 150-200 years.

Although this Association develops on rather specific habitats, it appears fairly widespread in portions of western Washington. Franklin et al. (1979) recognize an Abam/Bene h.t. for Mount Rainier National Park, where they say it is common in the eastern drainages. Many of these stands appear to belong to the depauperate phase listed below. Franklin (1966) lists an Abam/Bene Association for the area south of Mount Rainier. Dyrness et al. (1974) do not identify the Abam/Bene h.t. in western Oregon. It is apparently replaced there by Abam/Rhma-Vaal/Coca. Members of this type were sampled by Henderson et al. (1979) but because of their low frequency, were lumped with either Abam/Gash or Abam/Xete. Del Moral and Long (1977) did not identify any community type in the Cedar River which could be related to Abam/Bene, nor did Del Moral (1973) in Findley Lake Basin or Del Moral et al. (1976) in the Alpine Lakes Wilderness Area, or Fonda and Bliss (1969) for the Olympics.

Commonly communities will develop on the Abam/Bene h.t. with a very sparse understory layer. We identify this condition as a phase of Abam/Bene; however, it may be more appropriate under the proposed Resources Evaluation Team (RET) guidelines to call this condition a variant. Either way it

represents a special condition which commonly develops in the dry portion of the Abam zone, but where Vame, Xete, Gash and Vaal cannot or do not develop, leaving a sparse cover of residual, minor species including Bene, Chum, Chme, Clun, and Libo2. Care should be taken in assigning a sparse or depauperate community to Abam/Bene, as it could also belong to Abam/Vaal. It is unclear whether this condition is the product of excessive crown closure of the overstory, thus inhibiting the development of understory species, or peculiarly limiting environmental factors which preclude those species which can develop a more substantial ground cover. If the latter were so, it might be a basis for aggregating the Abam/Bene and Abam/Vaal depauperates into a new Association, which is not proposed here but due some future consideration.

Abies amabilis/Vaccinium membranaceum (Silver fir/Alaska huckleberry, Abam/Vame) Association

Two old-growth and six seral stands were sampled in the upper Green River drainage between Huckleberry Mountain and Pyramid Peak. The Association description is based on these two plots from this area, but data from all eight plots are used in the analysis of succession, distribution and productivity. These plots ranged from 4000-5500 feet (1220-1675 m) and generally occurred on dry but cool upper slope positions on southwesterly aspects (Table II). Site index based on dominant trees (usually Douglas-fir) averaged 88.3 for all plots using Curtis et al. (1973). The two old-growth plots averaged 78 while the six younger stands averaged 92.4. Basal area on the two old-growth plots (mean age 262 yrs) averaged 210 $ft.^2/ac.$ (48 m^2/ha), while stands dating from the 1899 fire averaged 150 $ft.^2/ac.$ (Table II).

Understory composition is dominated and characterized by Vaccinium membranaceum. Xerophyllum tenax, Pachistima myrsinites, Rubus lasiococcus are also common constituents, while Viola sempervirens (probably V. orbiculata) Lupinus latifolius, Valeriana sitchensis in younger stands and Arnica sp. may also be found. Vaccinium scoparium, Arctostaphylos uva-ursi, Carex geyeri and Erigeron peregrinus were found on the early seral plots (Table IV).

Successional development following fire (or cutting) is slow. This type, representing both cool and dry extremes for this area, is not very suitable for tree reproduction. Generally the tree ages were 20-30 years younger than the known age of the burn with one stand lagging behind by 60 years, and others, not included in this analysis, even longer. A 20-year lag could be expected for the best sites in the type, under optimum conditions. Tree reproduction is probably enhanced by residual burned snags and down logs and by the resprouting plants of Vame and Xete. If regeneration lags too long, the Vame-Xete brush field will further delay the succession to forest.

Wildlife and recreational values on the Abam/Vame h.t. are fairly high, depending especially on the seral Vame-Xete community which yields high quantities of Vame fruits and Xete flowers.

This type appears fairly prone to wildfire judging by the rarity of stands on this type over 300 years. The environment here during the fire season is warm (occurring generally on southerly aspects) and at elevations and topographic positions where lightning strikes are common. The structure of forest stands in this type allows fire to spread easily with overlapping crowns often extending to the ground.

Numerous phases are described for this Association in the literature. Probably the -Xete, -Mefe, and -Rula Phases occur in this area. Insufficient data at this type do not allow further analysis or description of phases.

The Abam/Vame Association is described for the Olympics as Abam-Tsme/Vame (Henderson et al. 1979). Franklin et al. 1979 describe several habitat types with Abam and Vame as dominants but identify them as Abam/Rula, Abam/Rhal, Abam/Mefe and Abam/Xete. While we also recognize these Associations, many of the plots of Franklin et al. (1979) are better related to Abam/Vame (-Rula phase, -Mefe phase and -Xete phase). Del Moral et al. (1976) recognize the Abam/Vame/Clintonia uniflora community type and the closely related Tsme-Abam/Vame-Mefe community type in the vicinity of Big Snow Mountain to the north of this area and a series of "types," most of which would belong in the Abam/Vame habitat type, east of the Cascade crest.

The "mixed forest" of Del Moral (1973) for Findley Lake Basin appears to belong to Abam/Vame (-Xete phase). Types "F" and "G" of Del Moral and Long (1977), the Abam/Vame-Vaov and Abam-Tshe/Vame community types of the Cedar River watershed also appear to represent portions of the Abam/Vame Association, although our sampling did not include plots in this type for the Cedar River drainage. Zobel et al. (1976) include an Abam/Vame/Xete climax community type for the Central Oregon Cascades.

The Abam/Vame, including all of its numerous phases, is a common habitat type on drier, middle to high elevation sites in the Cascades and Olympics in Oregon and Washington.

Tsuga heterophylla Series

The Tsuga heterophylla (Tshe or western hemlock) series occupies about 68,000 acres (37%) of the upper Cedar and Green River drainages (Fig. 6); however, only about 9,000 acres (3600 ha, 14 miles ^{2}, 7%) of this is in Forest Service ownership. Much of the private ownership in the western hemlock zone has been cut over, leaving few remnant old-growth stands to sample. Nine of the 46 old-growth (20%) plots sampled in this area are in this series.

Six associations are recognized in this series from sampled stands in old growth or projections of sampled stands in early seral stages. The presence of most of these associations are confirmed by comparison with data from Del Moral and Long 1976, and Becking 1954. Their associations are Tshe/Gaultheria shallon, Tshe/Berberis nervosa, Tshe/Polystichum munitum, Tshe/Acer circinatum, Tshe/Oplopanax horridum and Tshe/Vaccinium alaskaense.

Of these six, only three were sampled in old-growth condition - Tshe/Bene, Tshe/Gash, and Tshe/Vaal. Productivity in sampled old-growth stands in this zone is only moderate at best as indicated by Douglas-fir site index (95-135, base 100) although basal area stocking is above average for our area (mostly 320-520 ft^2/ac.). However, the most productive sites (Tshe/Pomu and Tshe/Acci habitat types) have been cut over leaving few old-growth examples of these associations to sample. Site index values in these two river bottom and toe slope associations usually vary between 130-180. In general, the presence of the western hemlock series indicates higher productivity than higher elevation series (Abam, Tsme), however, in this case because of biases determined by past cutting patterns, only poorer productivity sites remain in old-growth condition.

The western hemlock zone provides much of the area ungulate winter range as it is generally free of substantial or continual snow accumulations. Communities in this zone are also frequently dominant along the major streams, making them important Streamside Management Unit (SMU) or Riparian Area communities. Long term fire history in the western hemlock zone is somewhat obscured by recent cutting and land ownership patterns. The average age of existing old growth is 330 years, with the age of only one sampled stand exceeding 400 years. Most of this zone did not escape burning during the last major burning period 1630 to 1730 (250 to 350 years age).

Key to Associations in the Tshe Series

1. Devil's club (Opho) ≥ 5% . . . . . Tshe/Opho p. 39

1. Opho < 5% . . . . . (2)

2. Alaska huckleberry (Vaal) ≥ 10% . . . . . Tshe/Vaal p. 40

2. Vaal < 10% . . . . . (3)

3. Salal (Gash) ≥ 10% . . . . . Tshe/Gash p. 41

3. Gash < 10% . . . . . (4)

4. Swordfern (Pomu) ≥ 10% . . . . . Tshe/Pomu p. 43

4. Pomu < 10% . . . . . (5)

5. Oregongrape (Bene) ≥ 5% . . . . . Tshe/Bene p. 45

5. Bene < 5% . . . . . (6)

6. Vine maple (Acci) ≥ 10% . . . . . Tshe/Acci[1]

6. Not as above, either a depauperate community (return to lead 1 and use relative cover instead of absolute cover) or community sampled in disturbed or seral condition or undescribed Tshe Association for this area.

[1] To be expected, but not sampled in old-growth condition.

Table V. Selected Environmental and Physical Features of Associations in the Tsuga heterophylla Series

	Tshe/Bene n=4	Tshe/Vaal n=5	Tshe/Gash n=3*
Elevation (ft.)	2920±60	3072±56	2440±4
Aspect	NW, SE	NW	S
Slope (%)	38±29	38±13	26±31
Top height (ft.)	44±8	42±5	33±11
DF SI (ft.)	117±20	107±17	133±4
BA ($ft.^2/ac.$)	415±95	306±135	270±30
Ave. Age	246±66	393±197	46±1

*Includes stands less than 200 years old.

Table VI. Constancy/Coverage Table for Association in the Tsuga heterophylla Series

	Tshe/Bene n=4	Tshe/Vaal n=5
PSMEM	10 (43)	10 (17)
TSHE	10 (41)	10 (52)
THPL	5 (8)	10 (7)
TABR	2 (1)	8 (13)
ABPR	5 (10)	2 (8)
ABAM	7 (4)	8 (3)
GASH	5 (1)	6 (4)
BENE	10 (8)	10 (13)
ACCI	10 (8)	4 (1)
VAPA	10 (1)	10 (6)
VAAL	5 (1)	10 (16)
VAME	5 (1)	6 (1)
MEFE	5 (1)	6 (1)
PAMY	.	.
OPHO		2 (9)
HODI	.	
LIBO2	7 (1)	10 (5)
COCA	2 (1)	8 (6)
CHUM	5 (2)	6 (1)
CLUN	5 (2)	8 (1)
TROV2	.	8 (1)
GOOB	7 (1)	.
VISE	10 (1)	6 (1)
CHME	10 (1)	.
ACTR	5 (1)	6 (2)
RULA	2 (1)	6 (1)
XETE	5 (1)	6 (4)
PYSE	7 (1)	10 (1)
LYCL		2 (1)
LICO3		6 (1)
RUUR	5 (1)	.
TRLA2	.	
POMUM	.	
BLSP		4 (1)
STRO		.
SMST		2 (1)
TITR	.	.
TIUN	2 (1)	4 (1)
RUPE		.
COME	.	6 (1)

Tsuga heterophylla/Oplopanax horridum (Western hemlock/Devil's Club, Tshe/Opho) Association

Communities representing this Association were not sampled in this area. Its presence is inferred from the known presence of Abam/Opho, a similar and somewhat higher elevation type and from the recognition of the type in Mount Rainier National Park (Franklin et al. 1979).

The Tshe/Opho habitat type if found would be expected to occur on well-watered valley bottoms below the Abam Zone and somewhat wetter sites than Tshe/Vaal. Site index should be above average for the Tshe zone, while basal area could be quite variable. The dominant shrubs in this type plus its topographic position would make it a desirable winter range for ungulates.

Tsuga heterophylla/Vaccinium alaskaense (Western hemlock/Alaska huckleberry, Tshe/Vaal) Association

Two old-growth stands were sampled in this type. Their ages were 327 and 394 years. They occurred at 2480 (756 m) and 2940 feet (896 m) elevation in Sunday Creek and Smay Creek, Greenwater drainage (Table V). Abam was present in small amounts (4%) cover in both plots suggesting that these plots are either assignable to Abam/Vaal (given 500 more years of succession, Abam might develop more than 10% cover) or they represent an intergrade between Abam/Vaal above and Tshe/Gash below. One plot should be assigned to a -Gash phase and the other to a -Bene phase. Productivity is about average for the Tshe zone for this area; this type being moister than average but also cooler.

Tsuga heterophylla/Gaultheria shallon (Western hemlock/Salal, Tshe/Gash) Association

Six stands were sampled on the Tshe/Gash habitat type, including only one old-growth community (plot 2304, age ca. 311 years in the upper Green River at 2470 feet elevation (753 m). This sample size is too small to adequately characterize this habitat type in this area. Even the 311 year old stand is barely old enough to begin to be able to describe the Association. This area has fewer examples of this type than the drier White River area to the South. The Tshe/Gash is generally a dry habitat type and is much more common in areas of less precipitation or drier soil. The average McArdle and Meyer (1930) site index for this type in this area was 122.5 which is higher than means for the same type on the White River Ranger District (SI = 95) and the Shelton Ranger District, Olympic National Forest (SI = 113).

Typically even young communities on the Tshe/Gash ht. are dominated by most or all members of the Gash union - Gaultheria shallon (Gash), Berberis nervosa (Bene), Acer circinatum (Acci), and Vaccinium parvifolium (Vapa). Rosa gymnocarpium (Rogy), Vaccinium alaskaense (Vaal), Linnaea borealis (Libo2) and Polystichum munitum (Pomu) may also be associated with this union on certain habitats. Pteridium aquilinum (Ptaq) may occur in high coverage in young communities on the drier portion of the Tshe/Gash h.t. (Table VI).

Numerous phases of this type are recognized. Discussion of the phases of this type will come when a larger sample is taken. For further information on the Tshe/Gash Association or habitat type see "The Plant Associations of the White River Ranger District.

The Tshe/Gash type is one of the earliest recognized and commonest in Western Washington. Spilsbury and Smith (1947) recognized the Gaultheria (Salal) Site type plus the Gaultheria - Parmelia and the Gaultheria - Usnea Site types.

This data shows an average site index for the Gaultheria type of 123 feet, the Gaultheria - Parmelia type of 95 and the Gaultheria - Usnea type of 70, their Gaultheria type being the moistest and the Gaultheria - Usnea being the driest. They also give an expected yield for the Gaultheria type of 10,500 ft^3/ac. at 100 years and 8,000 ft^3/ac. for the Gaultheria - Parmelia type. Their study area included all of Western Washington and Oregon as well as Vancouver Island and parts of British Columbia mainland. Their sampling was limited to even-aged, second growth stands of Douglas-Fir. The portion of their study that is directly relatable to the North Bend Ranger District has yet to be determined. However, it appears that since the average of 122.5 for the Green and Cedar Rivers is essentially the same as 123 for their Gaultheria Site type, that the Gash h.t. corresponds very nearly to the Gaultheria Site type of Spilsbury and Smith (1947).

Becking (1954) recognized what he called the Salal - Douglas Fir Forest type group for Western Washington and Oregon, which included the Lowland Salal, Madrono - Salal, Lichen - Salal, Montane Salal, Subalpine Salal, Willamette Valley Salal and Fog Belt Salal Douglas Fir Forest types. Of these the Lowland Salal and primarily the Montane Salal probably correspond to the Tshe/Gash h.t. in this area. He gives an average site index for the Salal type group of 120 and for the Montane Salal type of 122.

Del Moral and Long (1977) recognized a Psme/Gash drainage, which, no doubt occurred on the Tshe/Gash h.t. as a seral stage. Henderson et al. (1979) recognized the Tshe/Gash h.t. on the basis of sampled stands of Psme - Tshe/Gash in both the Hoh and Dosewallips drainages in the Olympics.

Dyrness et al. (1974) recognized the Pseudotsuga menziesii/Acer circinatum/ /Gaulteria shallon community, which is probably a seral stage on the Tshe/Gash h.t. and the Tsuga heterophylla/Rhododendron macrophyllum/ Gaultheria shallon Association in the Central Oregon Cascades.

Franklin et al. (1979) describes the Tsuga heterophylla/Gaultheria shallon habitat type for Mount Rainier National Park where it characterizes hot dry ridges at low elevations, especially in the Ohanapecosh and Nisqually River drainage.

Tsuga hetrophylla/Polystichum munitum (Western hemlock/Sword fern, Tshe/Pomu) Association

No old-growth stands were sampled which represent this Association. However, six second growth stands aged 37 to 65 years were sampled. All represented toe slope or river bottom sites from 1600 to 2100 ft. (488-640 m) elevation (Table V). Two occurred in the Cedar River drainage near Chester Morris Lake. The others were in the upper mainstream reaches of the Green River. Site index of Douglas-Fir averaged 148 ft. (as measured on three of the six plots). The other three were basal area of the Douglas-Fir stands averaged 270 ft^2/ac. (62 m^2/ha) while the red alder stands averaged 150.

Two distinctive successional pathways are recognized for the Tshe/Pomu habitat type (Figure 7), in this area. The red alder pathway is common on this type and appears to be initiated by either heavy scarification, as along old roads, or by logging scarification without burning. Whatever the cause, the red alder dominated successional stages on this type are common throughout Western Washington. Indeed, this is the commonest place for this to occur.

Since the Tshe/Pomu h.t. represents some of our most productive forest land, the fact that red alder dominates a considerable percentage of range, has significant implications. This represents much of the area where we should have the best chances to increase timber production through intensive silviculture.

Acer circinatum, Montia sibirica and Tolmeia menziesii are characteristic species in the alder communities. Actaea rubra and Chimophila menziesii were found in the Douglas-Fir communities. Polystichum munitum and Galium triflorum were common in both seres. Acer circinatum was found in the Douglas-Fir communities, but with smaller coverages than with alder (Table VI).

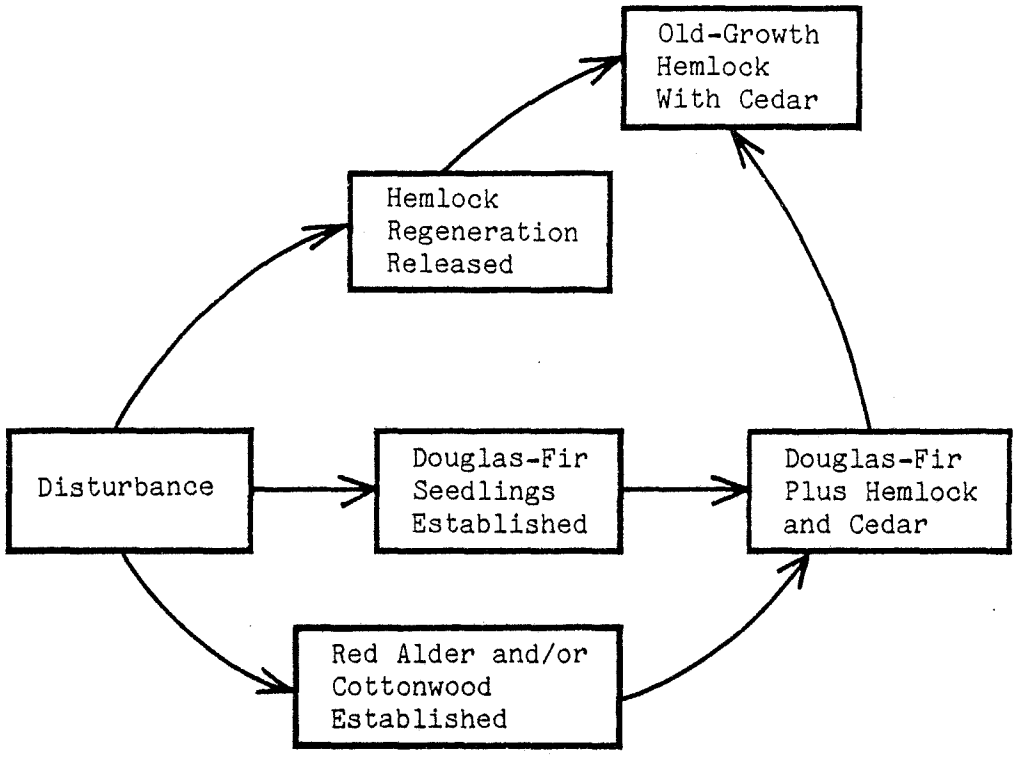


Figure 7. Successional pathways on the Tshe/Pomu habitat type

Tsuga heterophylla/Berberis nervosa (Western hemlock/Oregongrape, Tshe/Bene) Association

Seven stands, including five old growth, were sampled in the Green River drainage which represent the Tshe/Bene h.t. They occurred between 2100 and 3600 feet (640-1100 m) elevation, generally on moderate slopes and warm aspects. They appear to represent warm sites in the cool portion of the Tshe Zone. Average site index based on five of the sampled stands was 118, while the basal area of the five old-growth stands averaged 354 ft^2/ac. (81 m^2/ha). This type is fairly widespread in Western Washington but generally not common in any one place. It typically occurs at the ecotone between the Tshe Zone and Abam Zone.

Dyrness et al. (1974) recognizes the Pseudotsuga menziesii/Acer circinatum/ Berberis nervosa community type in the Central Cascades in Oregon. This type could represent a seral stage in the development of the Tshe/Bene or Tshe/Acci-Bene type there. Similarly Henderson et al. (1979) report on Abgr/Acci-Bene and a Tshe-Psme/Acci-Bene community type, both of which occur on the Tshe/Acci-Bene or Tshe/Bene h.t. in the Olympics. The Tshe/Acci-Bene type, although not recognized in the Green or Cedar River drainages is a closely related type of warmer sites and lower elevations than the Tshe/Bene type.

Little is known about the site relations or silvicultural implications on this type.

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APPENDIX

COMMONLY OCCURRING PLANTS ON
THE MT. BAKER-SNOQUALMIE NATIONAL FOREST

TREES

TRI code	Scientific Name	Common Name
ABAM	Abies amabilis	Pacific silver fir
ABGR	Abies grandis	Grand fir
ABLA2	Abies lasiocarpa	Subalpine fir
ABPR	Abies procera	Noble fir
ACMA	Acer macrophyllum	Bigleaf maple
ALRU	Alnus rubra	Red alder
CHNO	Chamaecyparis nootkatensis	Alaska yellowcedar
PIEN	Picea engelmannii	Englemann spruce
PISI	Picea sitchensis	Sitka spruce
PIAL	Pinus albicaulis	Whitebark pine
PIMO	Pinus monticola	Western white pine
POTR2	Populus trichocarpa	Black cottonwood
PSMEM	Pseudotsuga menziesii menziesii	Douglas-fir
RHPU	Rhamnus purshiana	Cascara buckthorn
SASC	Salix scouleriana	Scouler willow
TABR	Taxus brevifolia	Pacific yew
THPL	Thuja plicata	Western redcedar
TSHE	Tsuga heterophylla	Western hemlock
TSME	Tsuga mertensiana	Mountain hemlock

SHRUBS

ACCI	Acer circinatum	Vine maple
ACGL	Acer glabrum	Rocky Mt. maple
ALSI	Alnus sinuata	Sitka alder
AMAL	Amelanchier alnifolia	Saskatoon, serviceberry
ARCO3	Arctostophylos columbiana	Hairy manzanita
ARUV	Arctostaphylos uva-ursi	Bearberry, Kinnikinnick
BENE	Berberis nervosa	Low Oregon grape
CAME	Cassiope mertensiana	White Mt. heather
COCOC	Corylus cornuta californica	California hazelnut
CONU	Cornus nutallii	Pacific dogwood
GASH	Gaultheria shallon	Salal
HODI	Holodiscus discolor	Oceanspray
JUCO4	Juniperus communis	Common juniper
LOIN	Lonicera involucrata	Black twinberry
MEFE	Menziesia ferruginea	Rusty menziesia, Fool's huckleberry
OECE	Oemeleria cerasiformis	Indian plum
OPHO	Oplopanax horridum	Devil's club
PAMY	Pachistima myrsinites	Myrtle pachystima, Mt. lover
PHEM	Phyllodoce empetriformis	Red mountain heather
PREM	Prunus emarginata	Bitter cherry

TRI code	Scientific Name	Common Name
RHAL	Rhododendron albiflorum	Cascades azalea, white rhododendron
RIBR	Ribes bracteosum	Stink currant
RIHO	Ribes howellii	Mapleleaf currant
RILA	Ribes lacustre	Prickly currant
RISA	Ribes sanquineum	Red-flowering currant
RIVI	Ribes viscosissimum	Sticky currant
ROGY	Rosa gymnocarpa	Baldhip rose
RONU	Rosa nutcana	Nootka rose
RULE	Rubus leucodermis	Whitebark raspberry, Blackcap
RUPA	Rubus parviflorus	Western thimbleberry
RUSP	Rubus spectabilis	Salmonberry
SARA	Sambucus racemosa	Coast red elderberry
SOSC2	Sorbus scopulina	Cascade mountain ash
SOSI	Sorbus sitchensis	Sitka mountain ash
SPDE	Spiraea densiflora	Subalpine spiraea
SPDO	Spiraea douglasii	Douglas spiraea
SYAL	Symphoricarpos albus	Common snowberry
SYMOH	Symphoricarpos mollis hesperius	Creeping snowberry
VAAL	Vaccinium alaskense	Alaska huckleberry
VADE	Vaccinium deliciosum	Blue-leaf huckleberry
VAME	Vaccinium membranaceum	Thin-leaved huckleberry
VAOV	Vaccinium ovalifolium	Oval-leaf huckleberry
VAOV2	Vaccinium ovatum	Evergreen huckleberry
VAPA	Vaccinium parvifolium	Red huckleberry
VASC	Vaccinium scoparium	Grouse whortleberry

HERBS

ACMI	Achillea millefolium	Western yarrow
ACTR	Achlys triphylla	Vanillaleaf
ACRU	Actaea rubra	Baneberry
ADBI	Adenocaulon bicolor	Pathfinder
ADPE	Adiantum pedatum	Maidenhair fern
ANMA	Anaphalis margaritacea	Common pearly-everlasting
ANLY2	Anemone lyallii	Nine-leaved anemone
ANOR	Anemone oregana	Oregon anemone
ANLY	Angelica lyallii	Lyall's angelica
ANMI	Antennaria microphylla	Rosy pussy-toes
AQFO	Aquilegia formosa	Red columbine
ARLE	Arabis lemonnii	Lemmon's rockcress
ARMA3	Arenaria macrophylla	Bigleaf sandwort
ARCO	Arnica cordifolia	Heartleaf arnica
ARLA	Arnica latifolia	Broadleaf arnica
ASCA3	Asarum caudatum	Wildginger
ATFI	Athyrium filix-femina	Lady fern
BLSP	Blechnum spicant	Deer fern
BRSI	Bromus sitchensis	Alaska brome
BRVU	Bromus vulgaris	Columbia brome
CABI	Caltha biflora	White marshmarigold

TRI code	Scientific Name	Common Name
CASC2	Campanula scouleri	Scouler's hairbell
CADE	Carex deweyana	Dewey's sedge
CAGE	Carex geyeri	Elk sedge
CAINS	Carex interior	Inland sedge
CAME2	Carex mertensii	Merten's sedge
CAPH	Carex phaeocephala	Dunhead sedge
CARO	Carex rossii	Ross' sedge
CASPL	Carex spectabilis	Showy sedge
CAMI2	Castilleja miniata	Scarlet paintbrush
CAPA3	Castilleja parviflora	Magenta paintbrush
CHME	Chimaphila menziesii	Little pipsissewa
CHUM	Chimaphila umbellata	Common pipsissewa
CIAL	Circaea alpina	Enchanter's nightshade
CLLA	Claytonia lanceolata	Western spring beauty
CLUN	Clintonia uniflora	Queen's cup
COMA3	Corallorhiza maculata	Spotted coral-root
COME	Corallorhiza mertensiana	Merten's coral-root
COST2	Corallorhiza striata	Striped coral-root
COCA	Cornus canadensis	Bunchberry
COSC	Corydalis scouleri	Scouler's corydalis
CRCR	Cryptogramma crispa	Parsley-fern
DAGL	Dactylis glomerata	Orchard grass
DEAT	Deschampsia atropurpurea	Montain hairgrass
DIFO	Dicentra formosa	Pacific bleedingheart
DIHO	Disporum hookeri	Hooker's fairybell
DISM	Disporum smithii	Smith fairybell
DRAU2	Dryopteris austriaca	Spreading woodfern
ELGL	Elymus glaucus	Blue wildrye
EPAN	Epilobium angustifolium	Fireweed
EPGL	Epilobium glaberrimum	Common willow-herb
EPMI	Epilobium minutum	Small-flowered willow-herb
ERPE	Erigeron peregrinus	Wandering daisy
ERGR	Erythronium grandiflorum	Yellow fawnlily
ERMO	Erythronium montanum	Avalanche fawnlily
FEID	Festuca idahoensis	Idaho fescue
FERU	Festuca rubra	Red fescue
FEVI	Festuca viridula	Green fescue
FRVE	Fragaria vesca	Woods strawberry
FRVI	Fragaria virginiana	Broadpetal strawberry
GAAP	Galium aparine	Catchweed bedstraw
GAOR	Galium oreganum	Oregon bedstraw
GATR	Galium triflorum	Fragrant bedstraw
GAOV	Gaultheria ovatifolia	Slender wintergreen
GOOB	Goodyera oblongifolia	Western rattlesnake plantain
GYDR	Gymnocarpium dryopteris	Oak fern
HIAL	Hieracium albiflorum	White flowered hawkweed
HIGR	Hieracium gracile	Western hawkweed
HYTE	Hydrophyllum tenuipes	Slender-stemmed waterleaf
HYRA	Hypocharis radicata	Hairy cat's ear
HYMO	Hypopitys monotropa	Pinesap

TRI code	Scientific Name	Comon Name
LAMU	Lactuca muralis	Wall lettuce
LIGR	Ligusticum grayii	Gray's lovage, Mt. ligusticum
LICO4	Lilium columbianum	Tiger lily, Columbia lily
LIBO2	Linnaea borealis	Twinflower
LICA3	Listera caurina	Western tway-blade
LICO2	Listera convallarioides	Broad-lipped twayblade
LICO3	Listera cordata	Heart-leaf twayblade
LUPE	Luetkea pectinata	Partridge foot
LULA	Lupinus latifolius	Broadleaf lupine
LUCA2	Luzula campestris	Field woodrush
LUHI	Luzula hitchcockii	Smooth woodrush
LYCL	Lycopodium clavatum	Ground pine
LYAM	Lysichitum americanum	Skunk cabbage
MADI	Maianthemum dilatatum	Beadruby
MIBR	Mitella breweri	Brewer's mitrewort
MOSI	Montia siberica	Candyflower
NONE	Nothochelone nemorosa	Woodland beardtongue
OSCH	Osmorhiza chilensis	Mountain sweet-cicely
PEBR	Pedicularis bracteosa	Bracted lousewort
PERA	Pedicularis racemosa	Leafy lousewort
PEFRP	Petasites frigidus palmatus	Sweet coltsfoot
PHAL	Phleum alpinum	Alpine timothy
PHDI	Phlox diffusa	Spreading phlox
POPU	Polemonium pulcherrimum	Skunkleaf polemonium
POBI	Polygonum bistortoides	American bistort
POGL4	Polypodium glycyrrhiza	Licorice fern
POMUI	Polystichum munitum imbricans	Swordfern
POMUM	Polystichum munitum munitum	Swordfern
PTAQ	Pteridium aquilinum	Bracken fern
PTAN	Pterospora andromedea	Pinedrops
PYAS	Pyrola asarifolia	Common pink pyrola
PYMI	Pyrola minor	Lesser wintergreen
PYPI	Pyrola picta	Whitevein pyrola
PYSE	Pyrola secunda	One-sided pyrola
PYUN	Pyrola uniflora	Woodnymph
RAES	Ranunculus eschscholtzii	Subalpine buttercup
RULA	Rubus lasiococcus	Dwarf bramble, trailing b.
RUNI	Rubus nivalis	Snow bramble
RUPE	Rubus pedatus	Five-leaved bramble, trailing b.
RUUR	Rubus ursinus	Pacific blackberry
RUAC	Rumex acetosella	Sheep sorrel
SEDI	Sedum divergens	Spreading sedum
SETR	Senecio triangularis	Arrowleaf groundsel
SMBA	Smilacina racemosa	Western solomon-plume, large false solomon seal
SMST	Smilacina stellata	Starry solomon-plume, small false solomon seal
STME2	Stachys mexicana	Mexicana, hedge-nettle
STAM	Streptopus amplexifolius	Clasping-leaved twisted-stalk
STRO	Streptopus roseus	Rosy twisted-stalk
TITR	Tiarella trifoliata	Three-leaved foamflower
TIUN	Tiarella unifoliata	One-leaved foamflower

TRI code	Scientific Name	Common Name
TOME	Tolmiea menziesii	Youth-on-age, Pig-a-back
TRCA3	Trautvetteria caroliniensis	False bugbane
TRLA2	Trientalis latifolia	Broad-leaved starflower
TRRE	Trifolium repens	Dutch clover
TROV2	Trillium ovatum	White trillium, Wakerobin
TRCA	Trisetum canescens	Tall trisetum
TRCE	Trisetum cernuum	Nodding trisetum
TRSP	Trisetum spicatum	Spike trisetum
VASI	Valeriana sitchensis	Sitka valerian
VEVI	Veratrum viride	Green false hellebore
VIGL	Viola glabella	Pioneer violet
VIOR	Viola orbiculata	Round-leaved violte
VISE	Viola sempervirens	Evergreen violet
XETE	Xerophyllum tenax	Common beargrass

Trees

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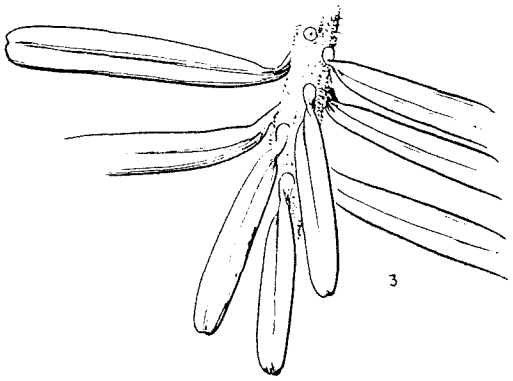
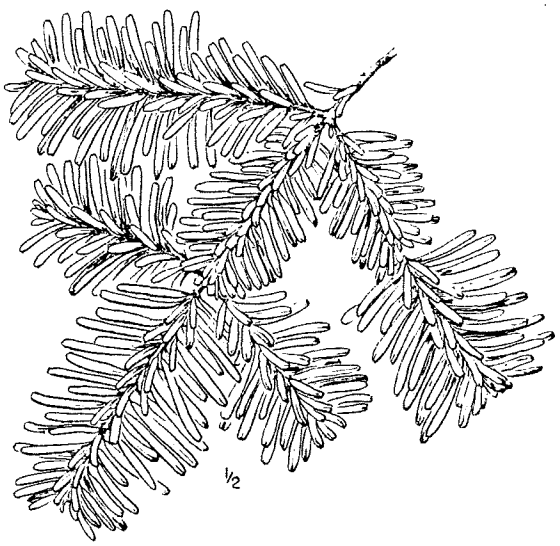
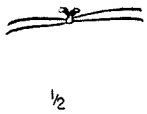
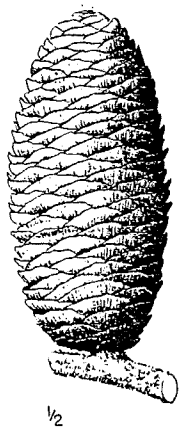
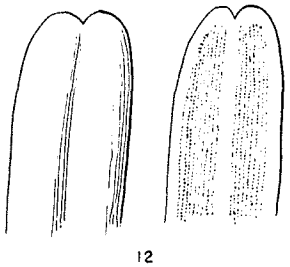






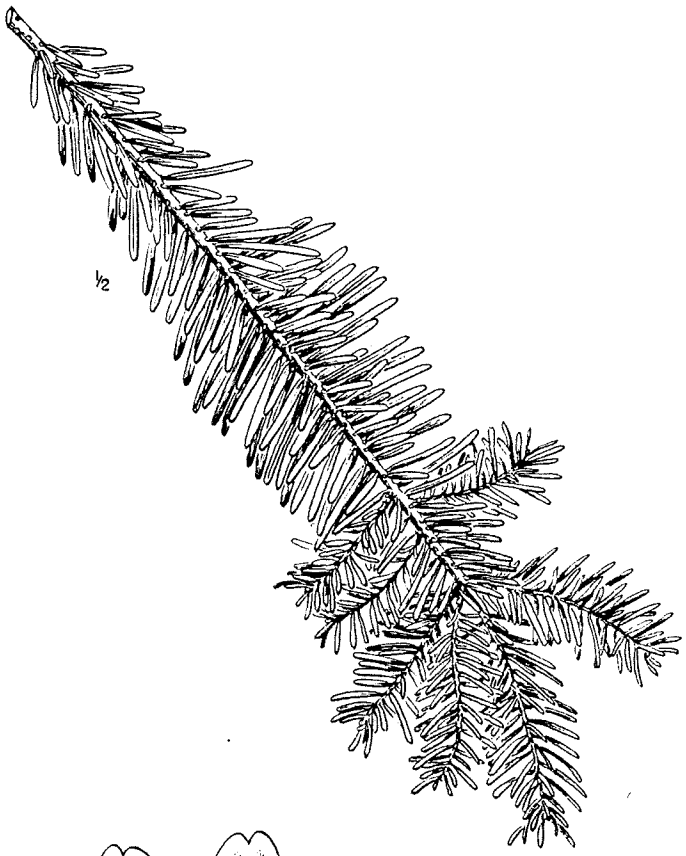


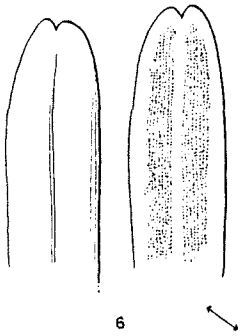


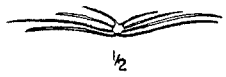
PACIFIC SILVER FIR

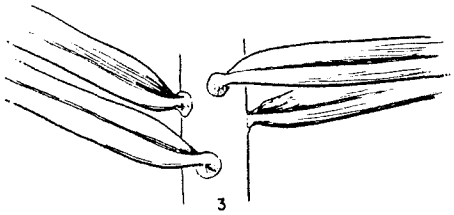
Abies amabilis

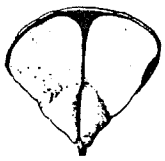
(Abam)

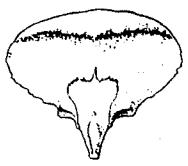








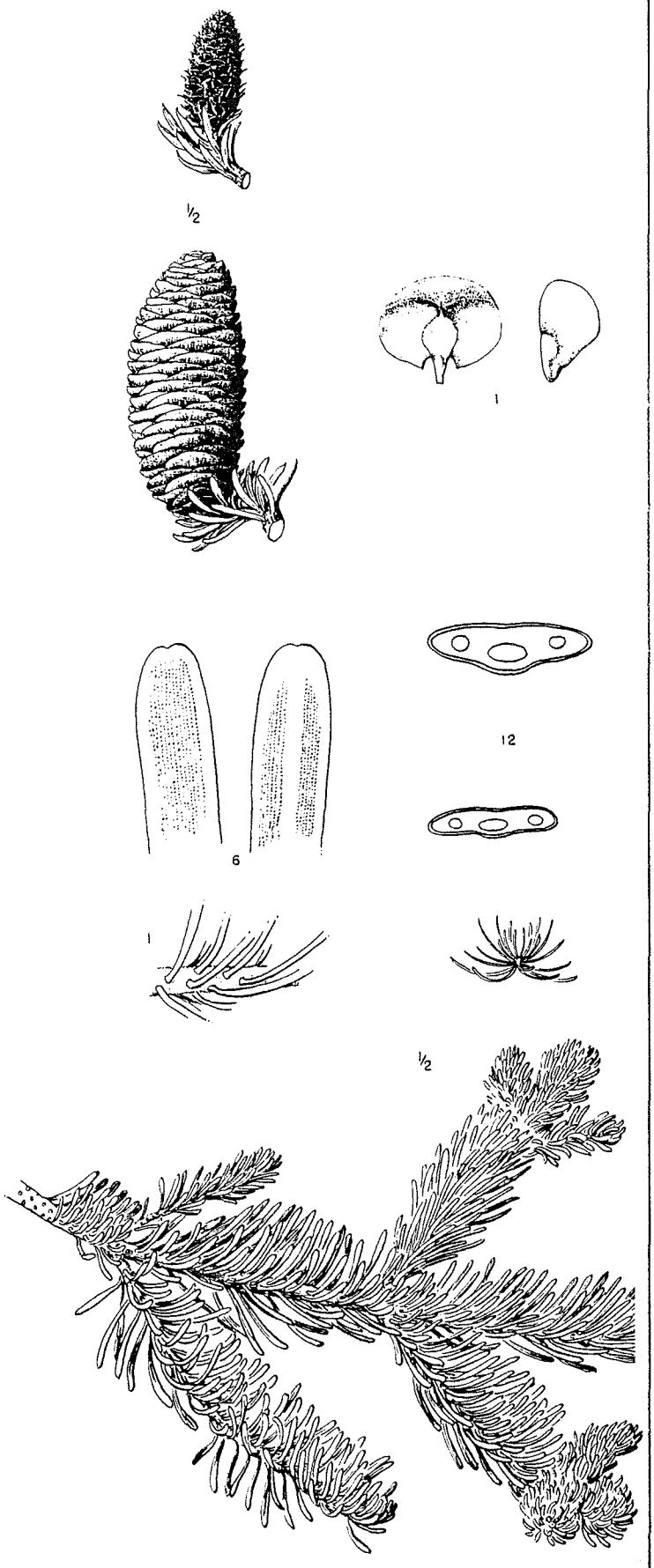




GRAND FIR

Abies grandis

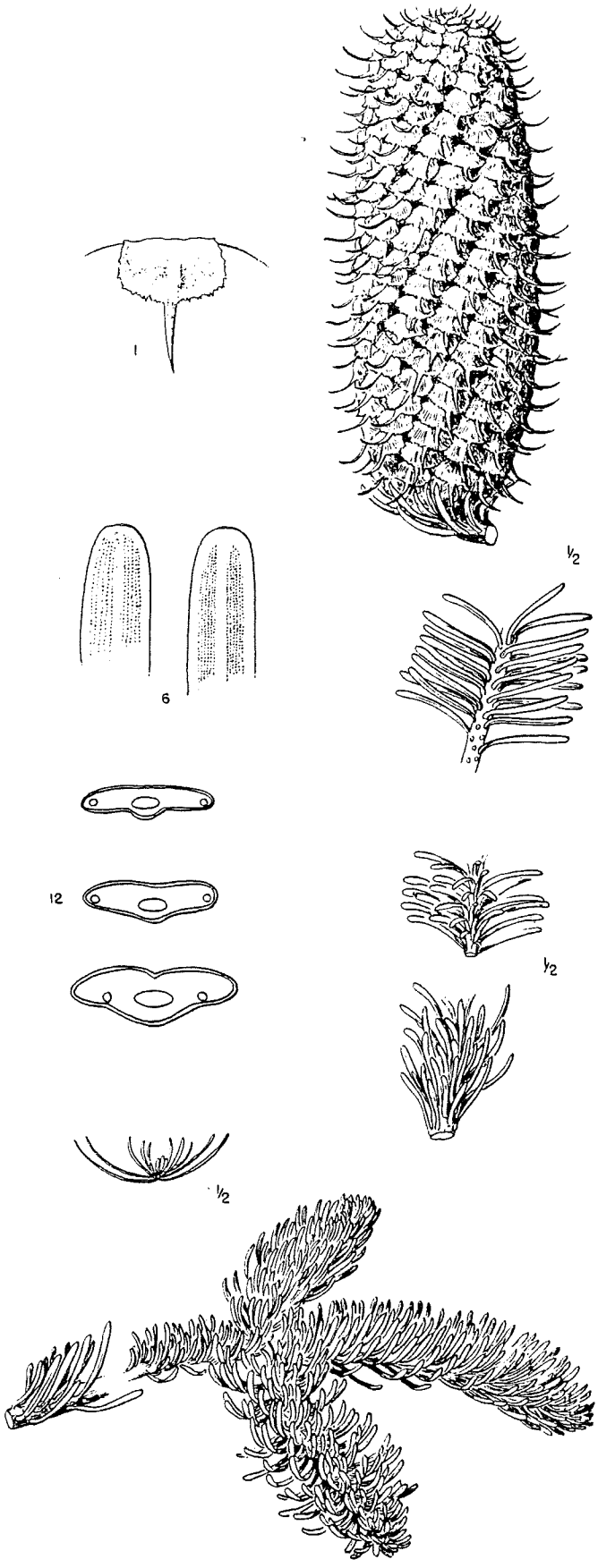
(Abgr)



SUBALPINE FIR

Abies lasiocarpa

(Abla2)



NOBLE FIR

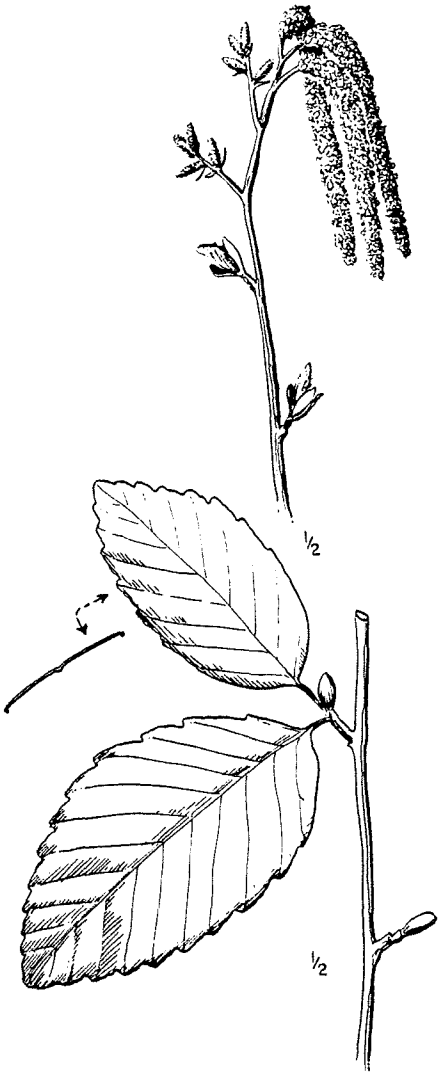
Abies procera

(Abpr)

BIGLEAF MAPLE

Acer macrophyllum

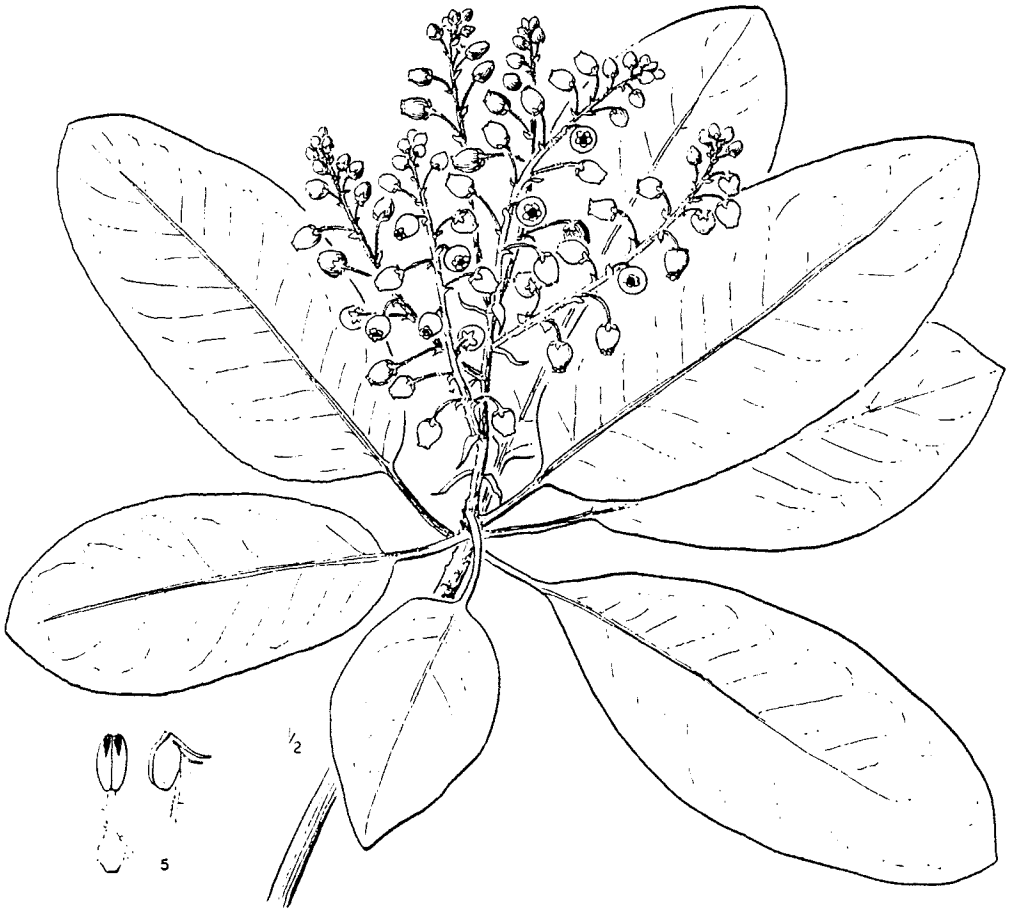
(Acma)



RED ALDER

Alnus rubra

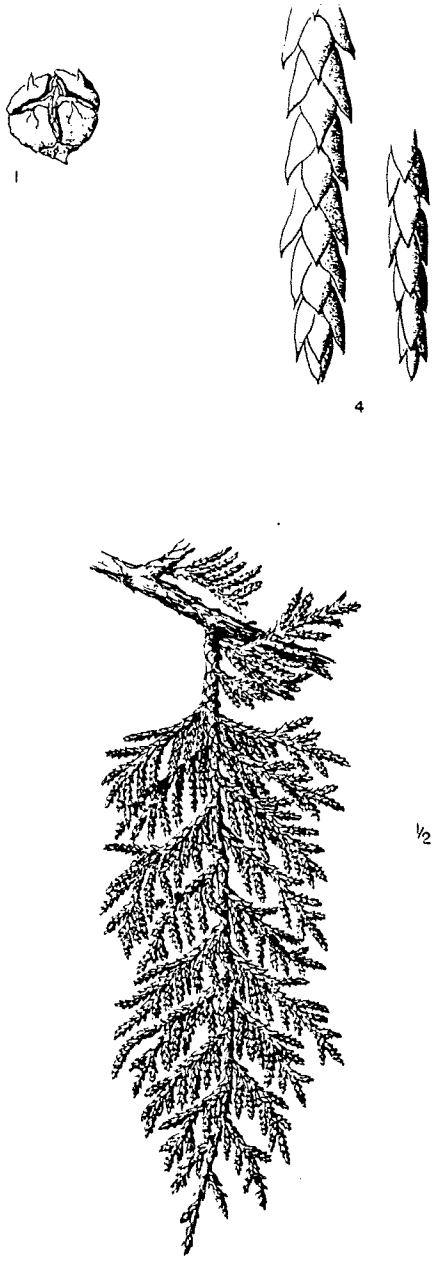
(Alru)



PACIFIC MADRONE

Arbutus menziesii

(Arme)



ALASKA YELLOWCEDAR

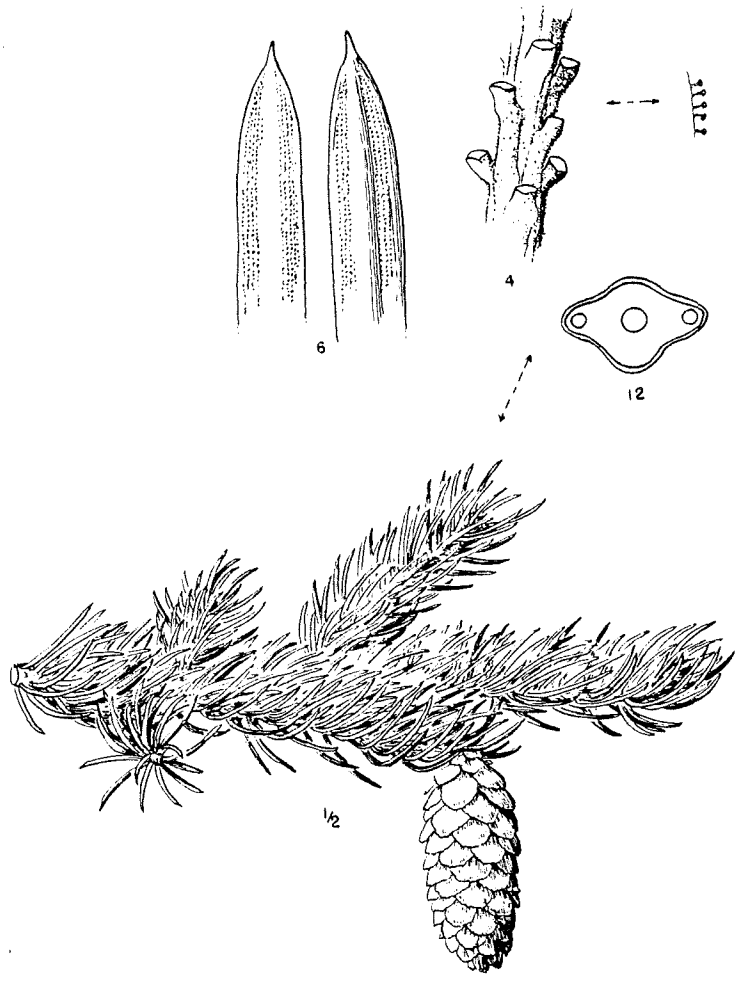
Chamaecyparis nootkatensis

(Chno)

PACIFIC DOGWOOD

Cornus nuttallii

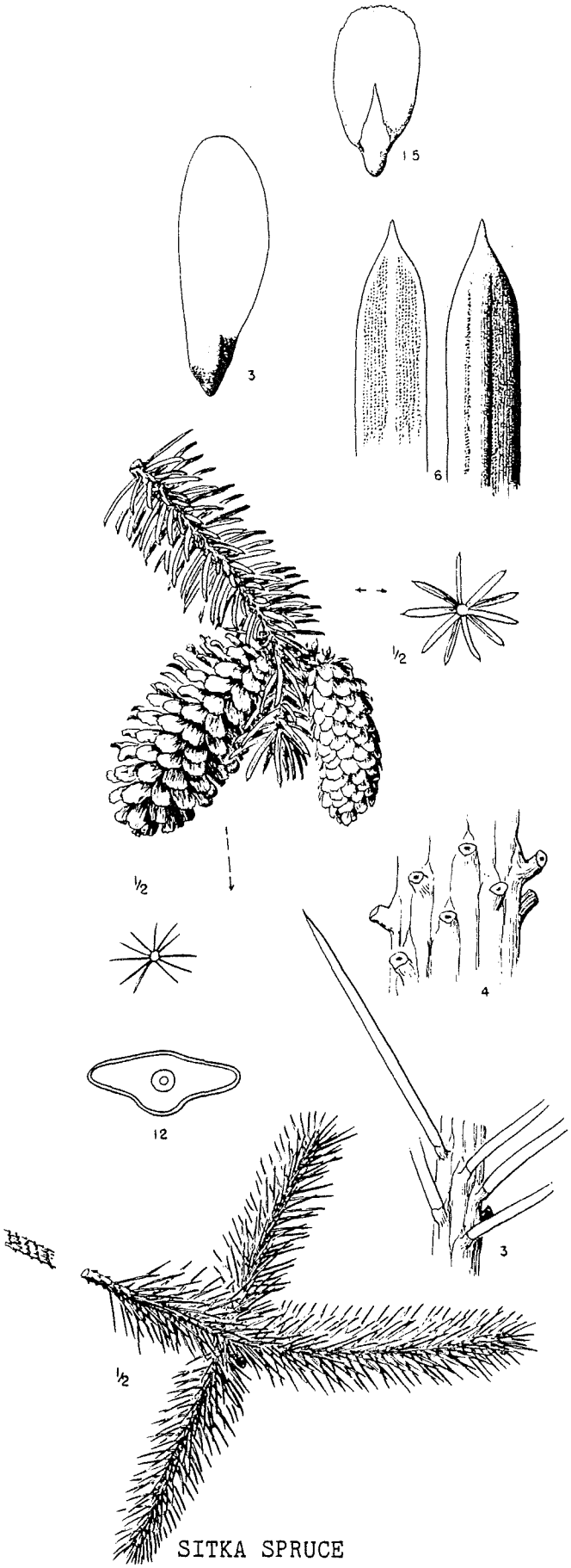
(Conu)



ENGLEMANN SPRUCE

Picea engelmannii

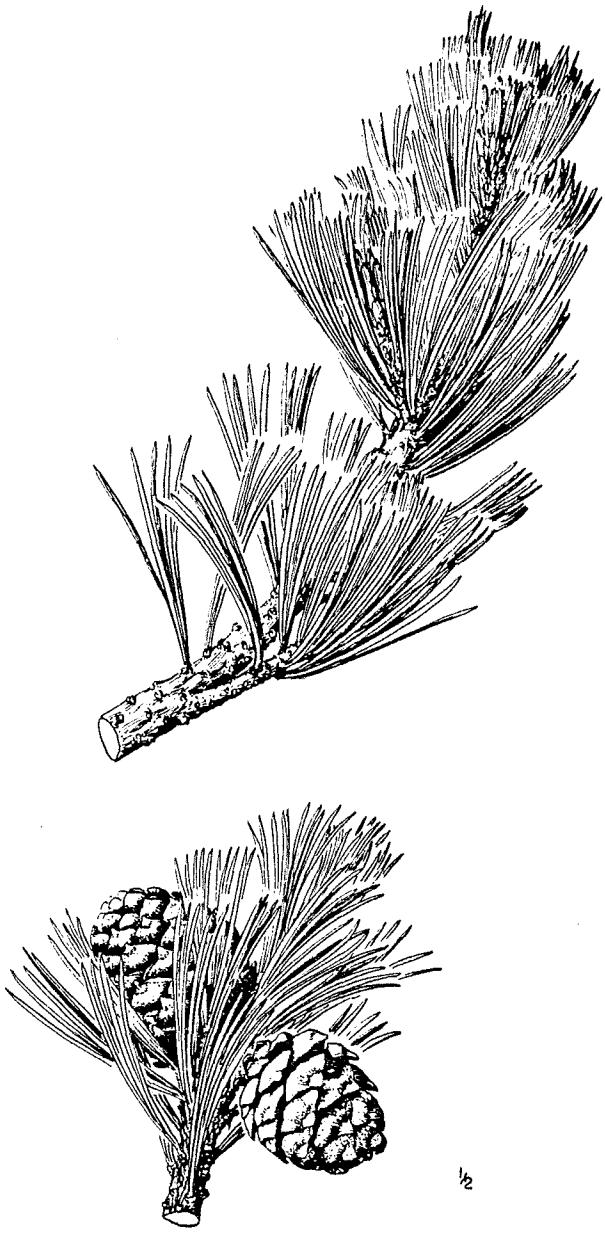
(Pien)



SITKA SPRUCE

Picea sitchensis

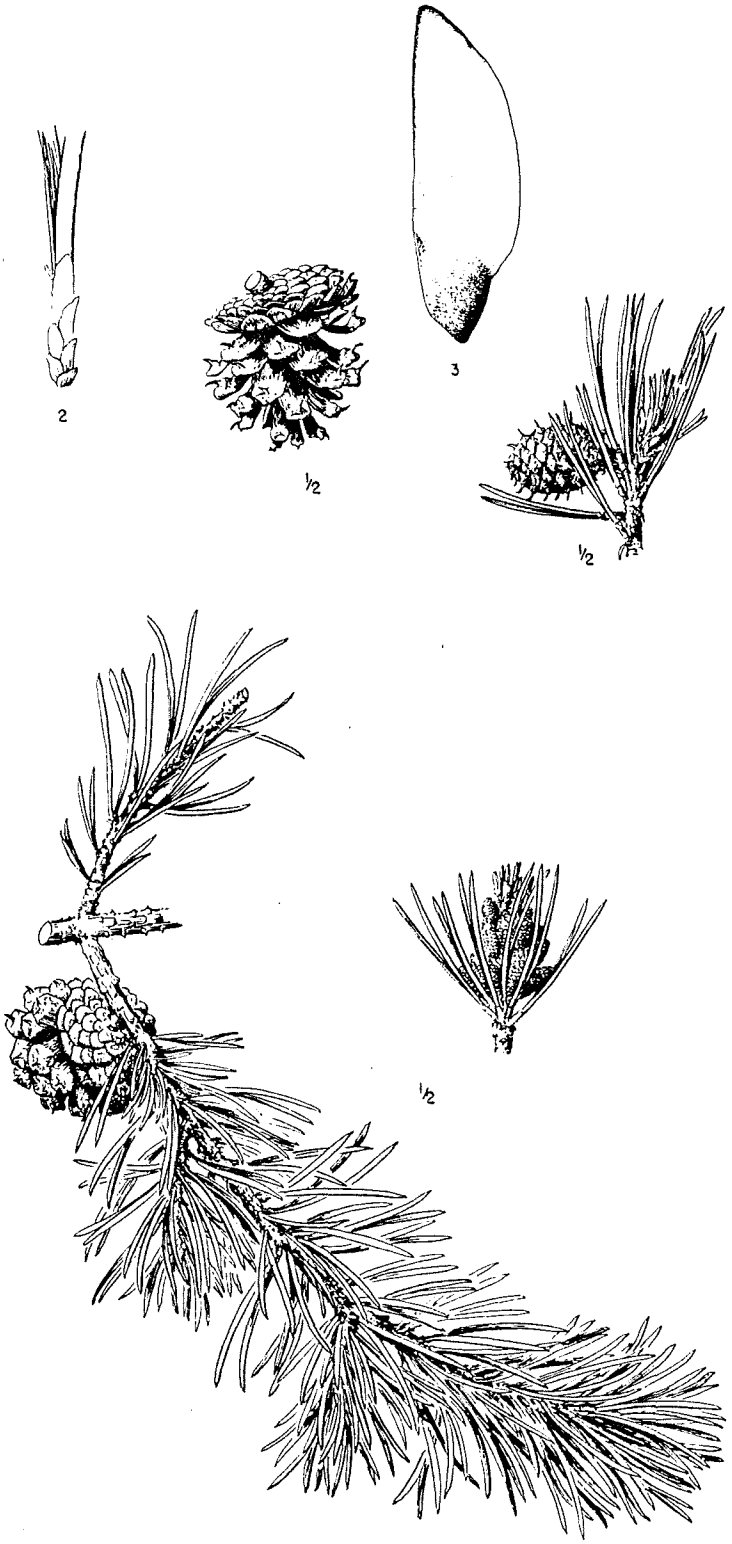
(Pisi)



WHITEBARK PINE

Pinus albicaulis

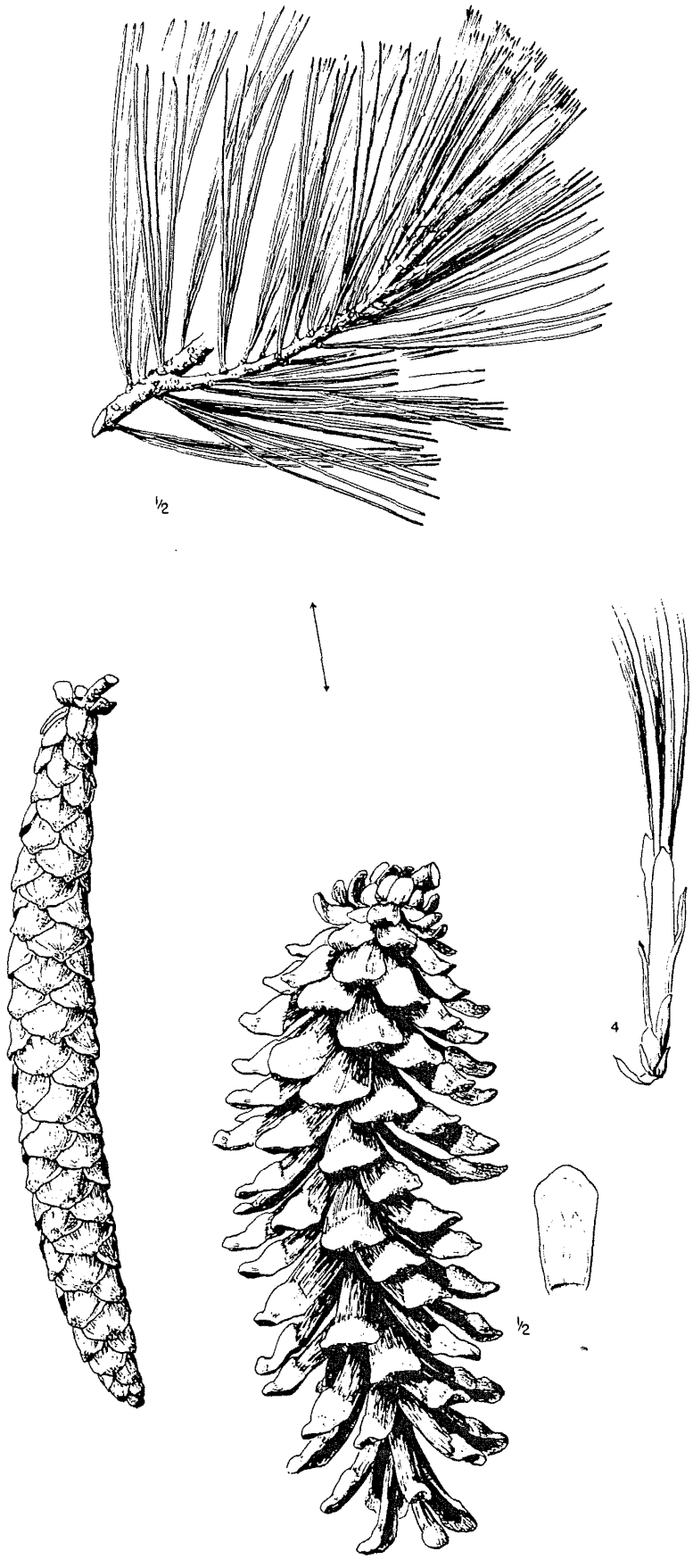
(Pial)



LODGEPOLE PINE

Pinus contorta

(Pico)



WESTERN WHITE PINE

Pinus monticola

(Pimo)

BLACK COTTONWOOD

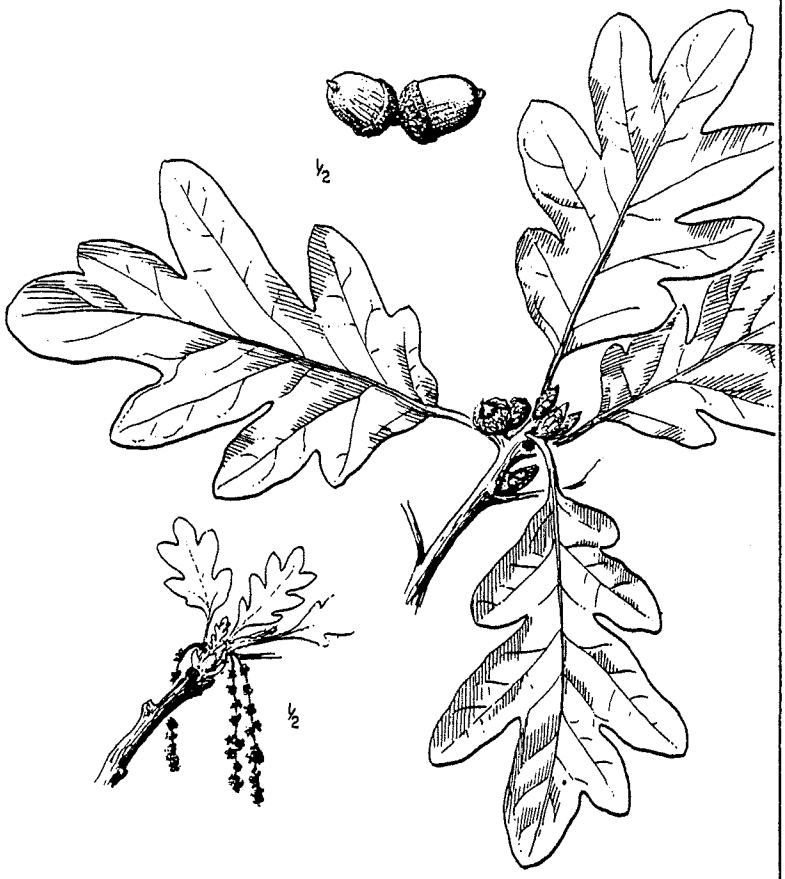
Populus trichocarpa

(Potr2)

DOUGLAS-FIR

Pseudotsuga menziesii menziesii

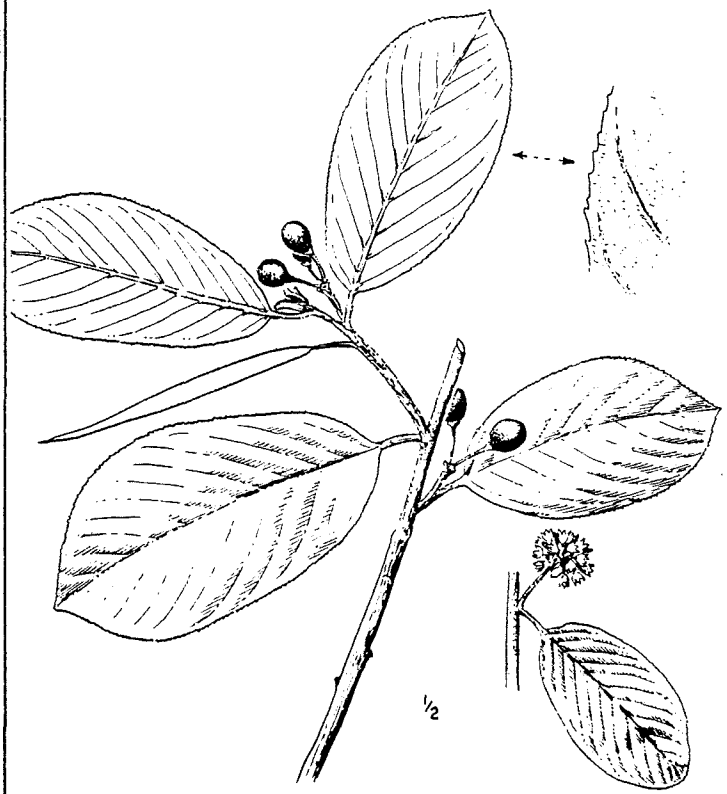
(Psmem)



GARRY OAK

Quercus garryana

(Quga)



CASCARA BUCKTHORN

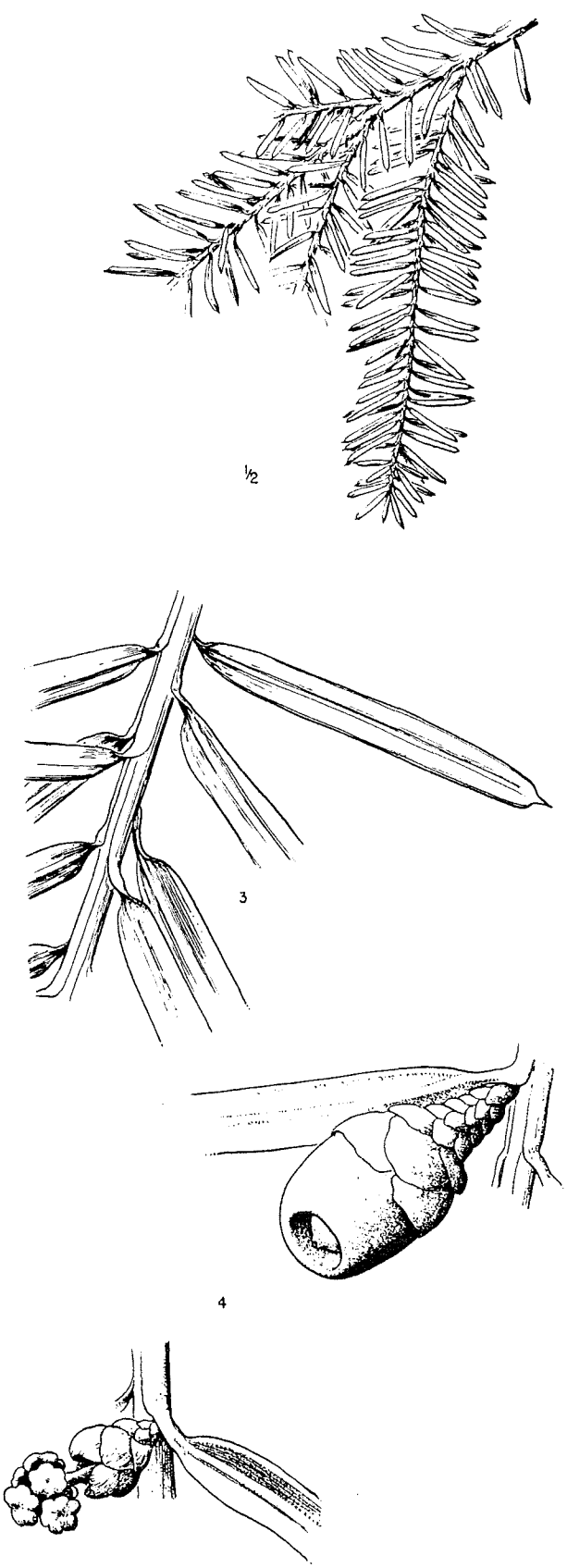
Rhamnus purshiana

(Rhpu)

SCOULER WILLOW

Salix scouleriana

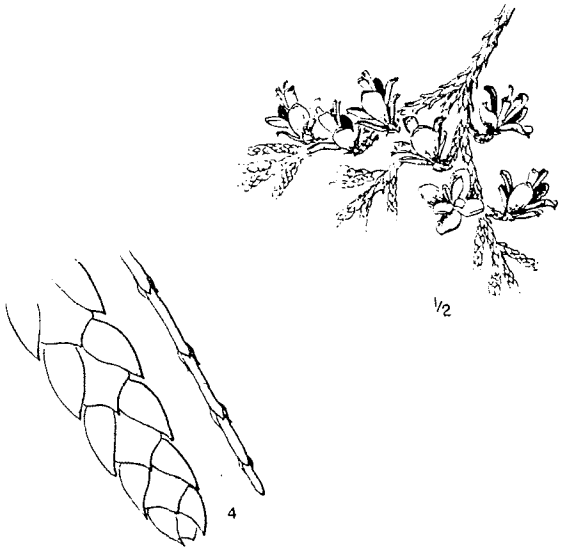
(Sasc)

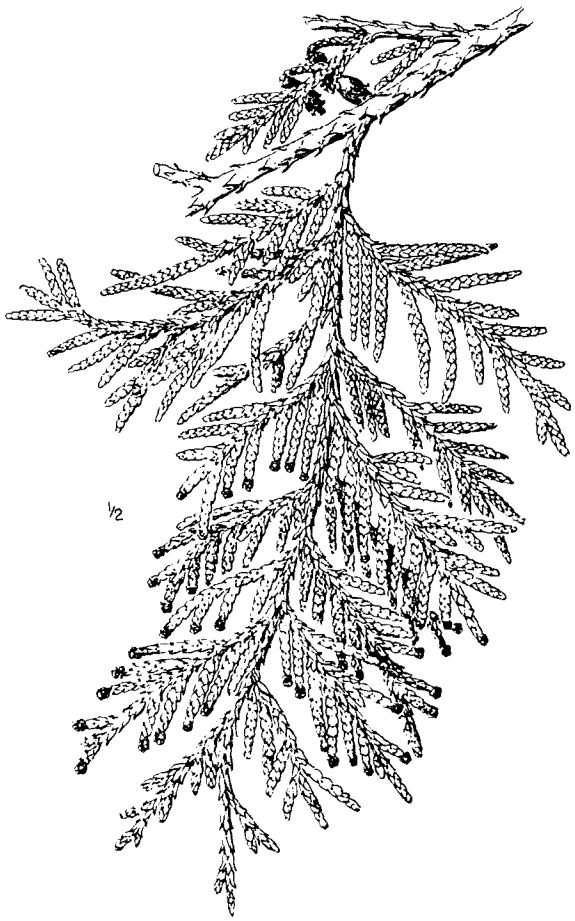


PACIFIC YEW

Taxus brevifolia

(Tabr)

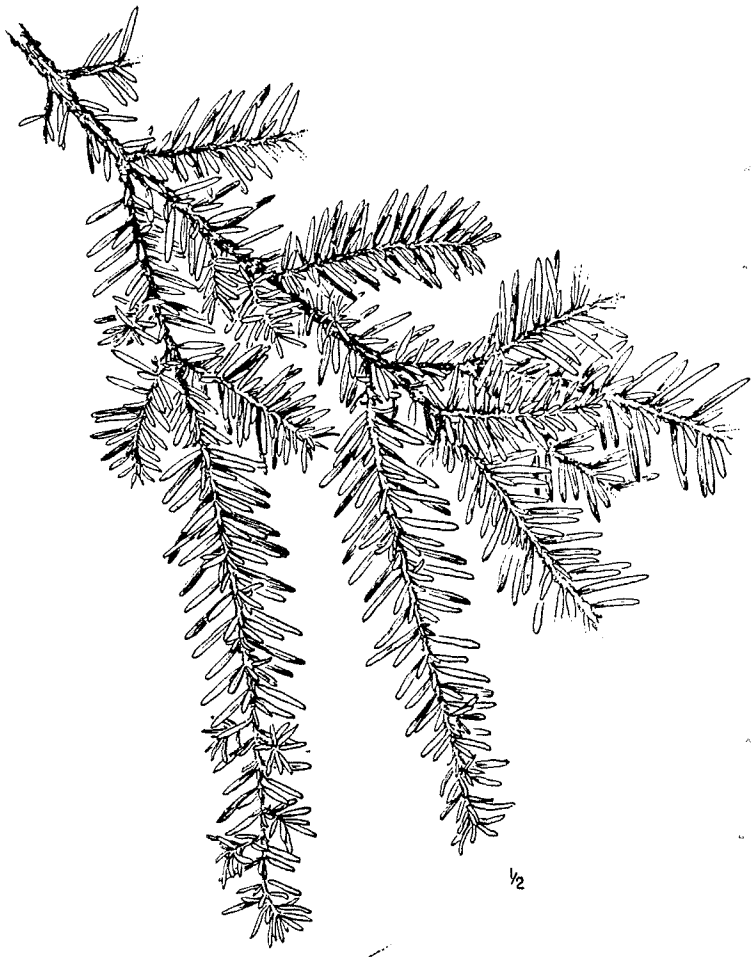


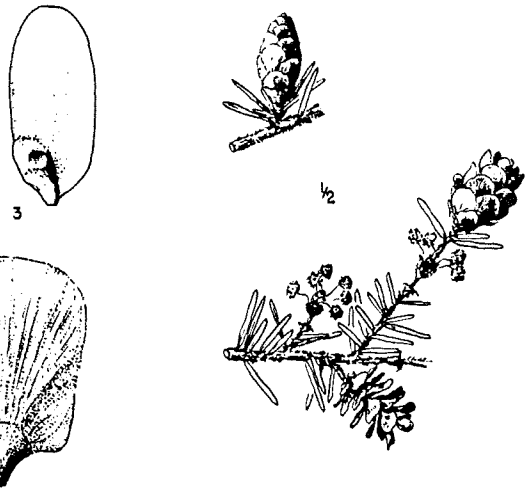


WESTERN REDCEDAR

Thuja plicata

(Thpl)

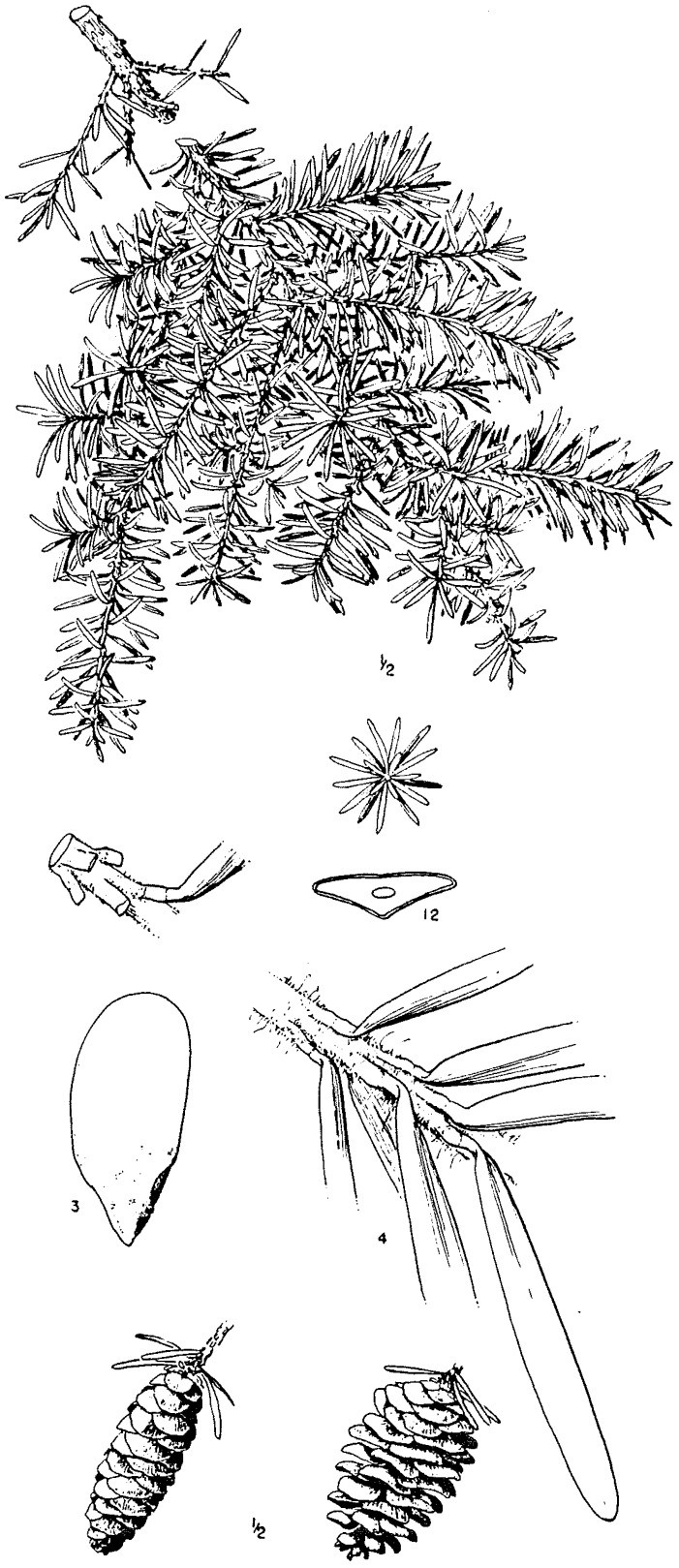




WESTERN HEMLOCK

Tsuga heterophylla

(Tshe)



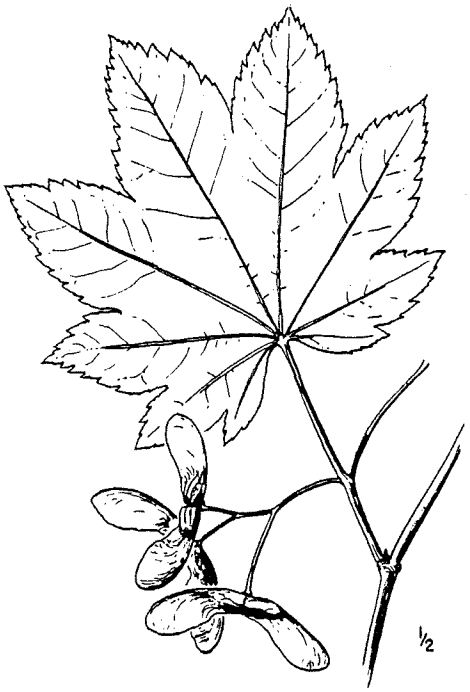
MOUNTAIN HEMLOCK

Tsuga mertensiana

(Tsme)

Shrubs

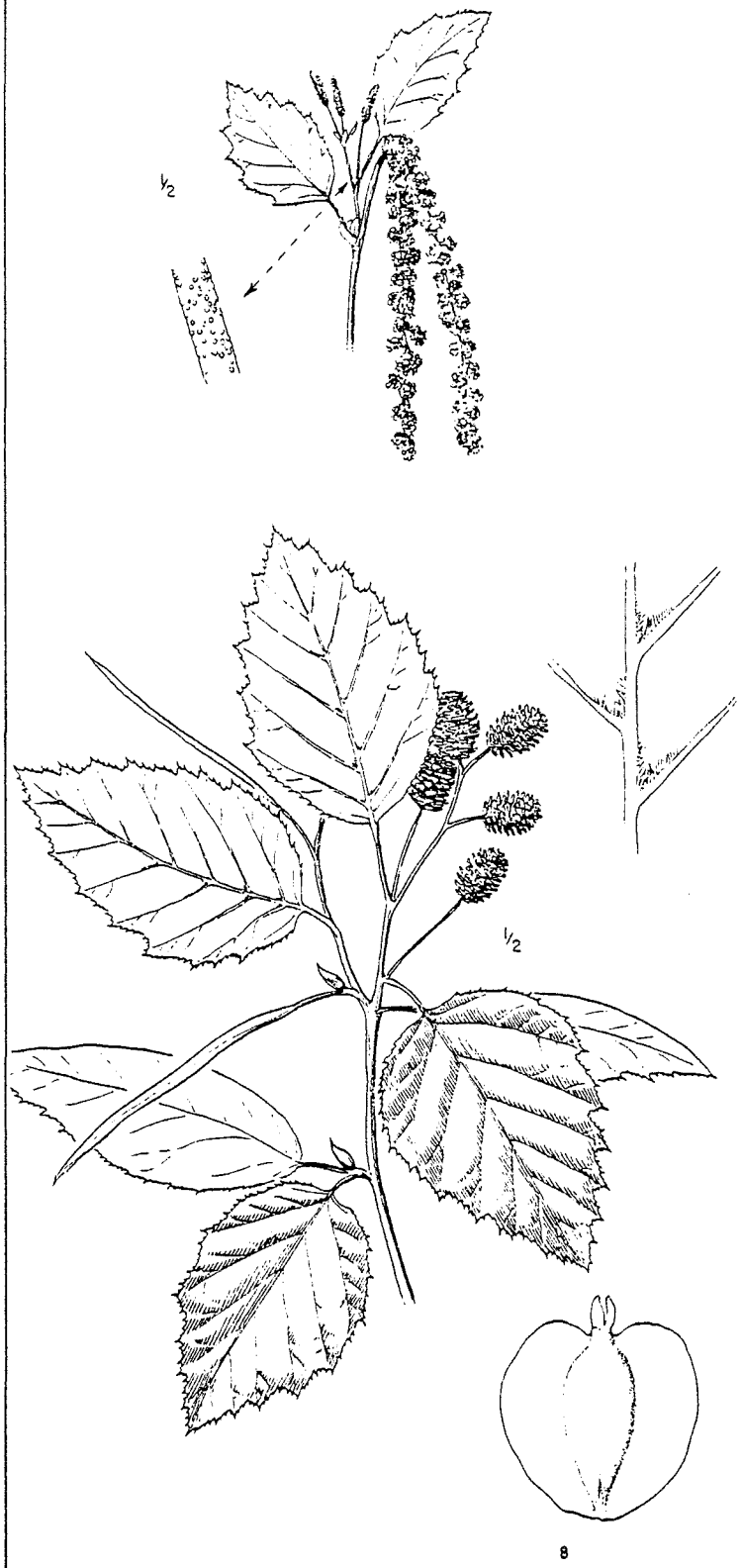
The following illustrations by Jeanne R. Janish and reproduced by permission from Hitchcock et al. 1955-1969. Vascular Plants of the Pacific Northwest.



VINE MAPLE

Acer circinatum

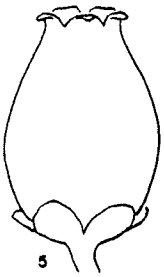
(Acci)

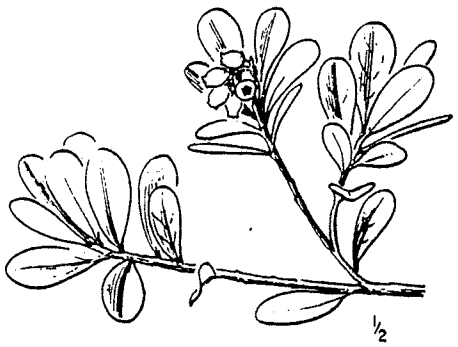


SITKA ALDER

Alnus sinuata

(Alsi)

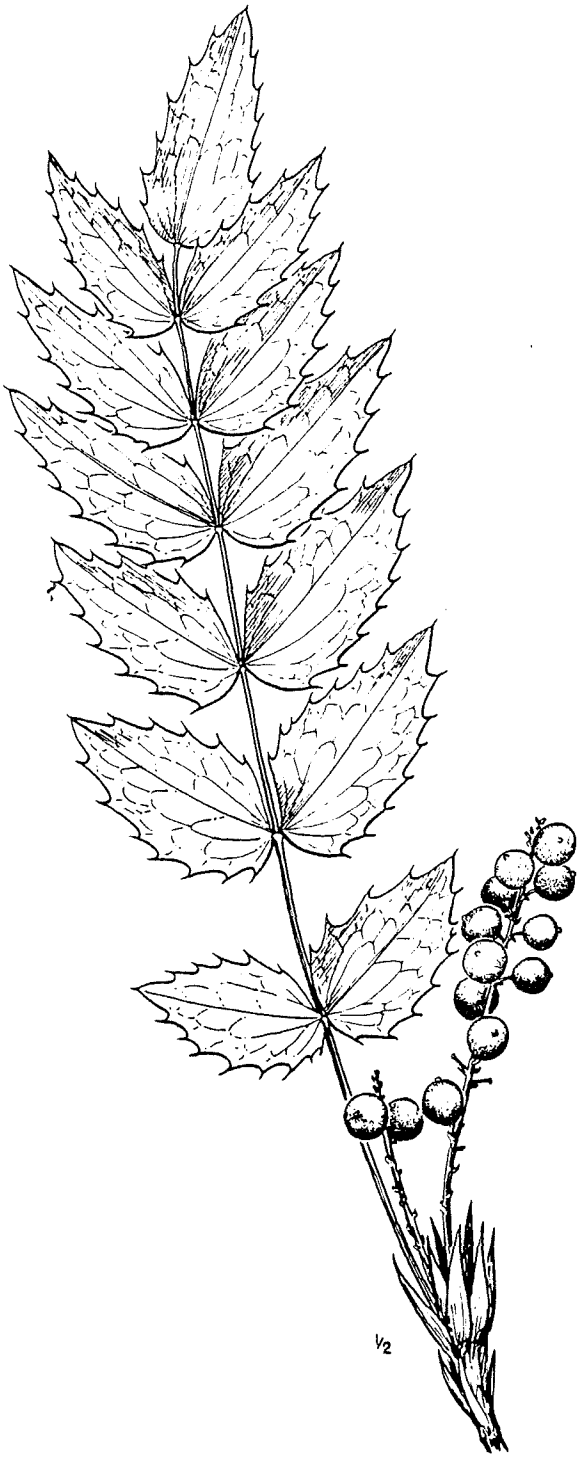




BEARBERRY, KINNIKINNICK

Arctostaphylos uva-ursi

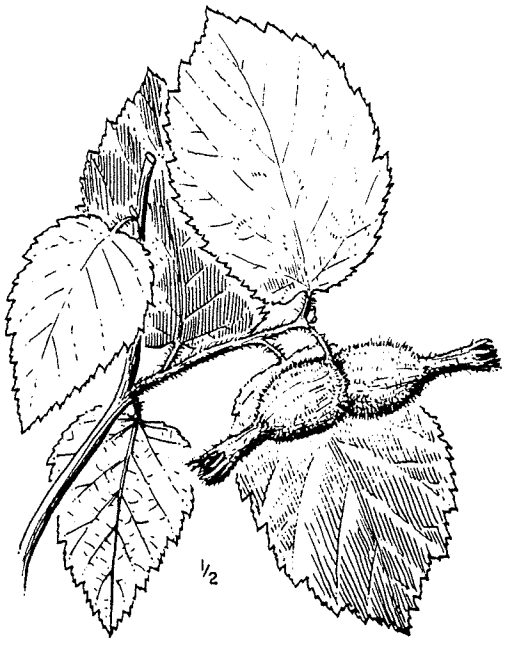
(Aruv)



LOW OREGONGRAPE

Berberis nervosa

(Bene)



CALIFORNIA HAZELNUT

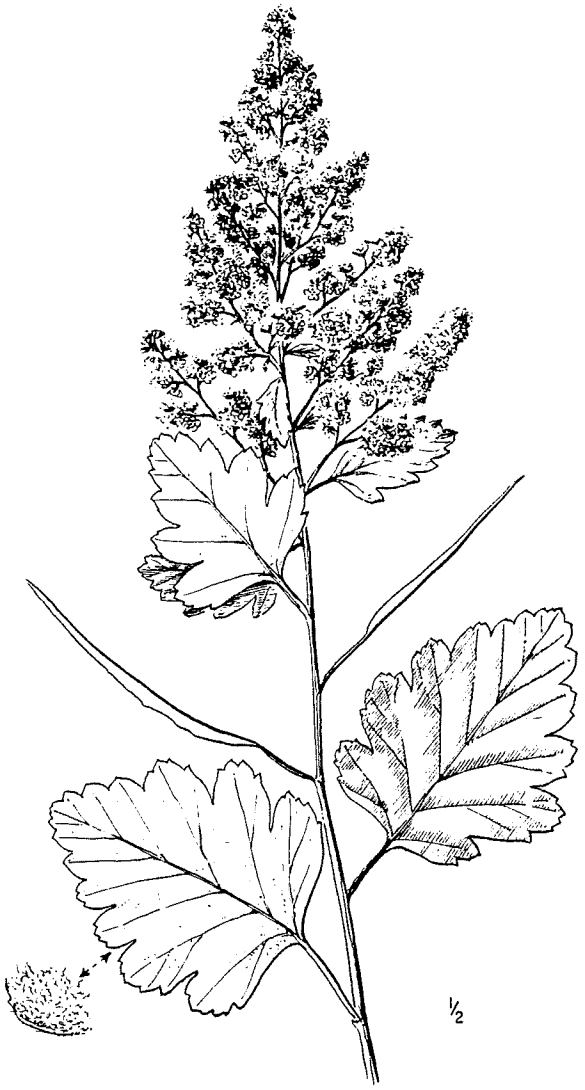
Corylus cornuta californica

(Cococ)

SALAL

Gaultheria shallon

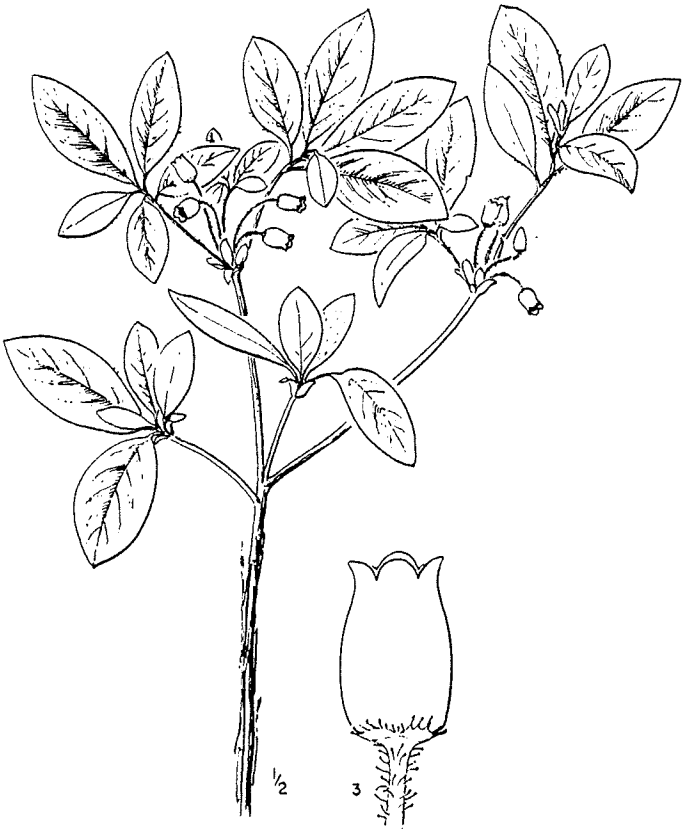
(Gash)



OCEANSPRAY

Holodiscus discolor

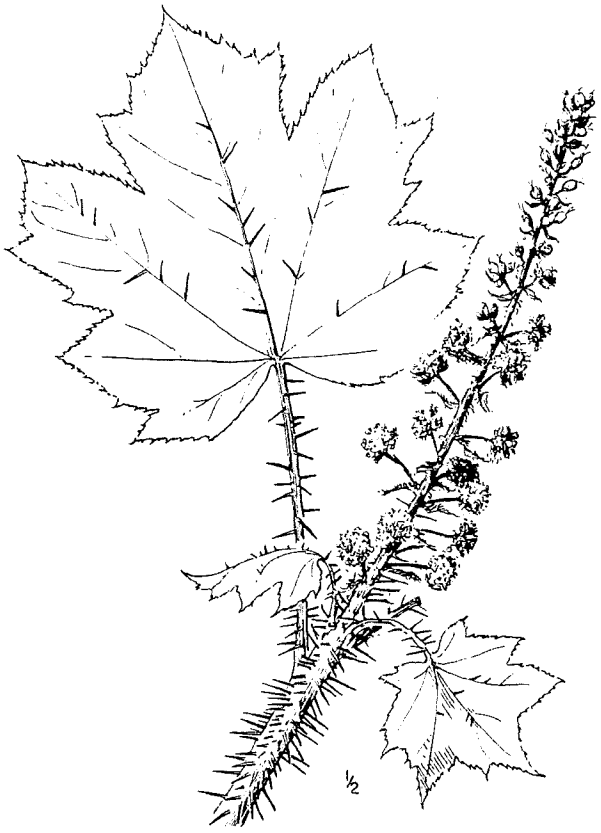
(Hodi)



RUSTY MENZIESIA, FOOL'S HUCKLEBERRY

Menziesia ferruginea

(Mefe)



DEVIL'S CLUB

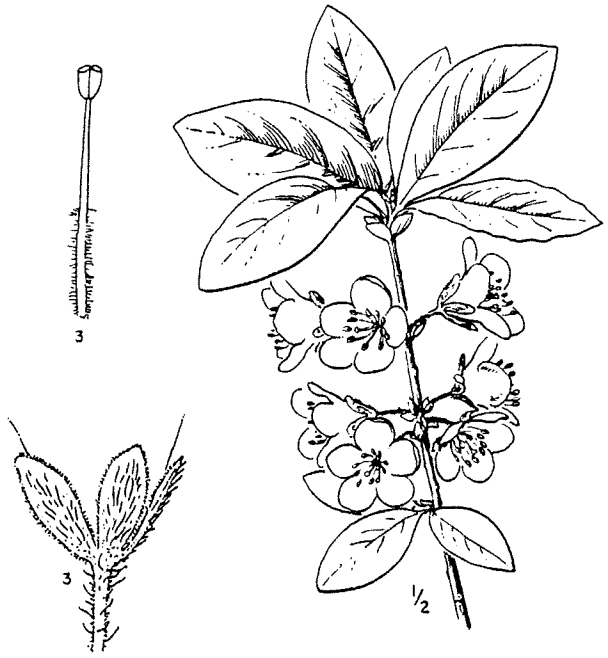
Oplopanax horridum

(Opho)

MYRTLE PACHYSTIMA, MT. LOVER

Pachistima myrsinites

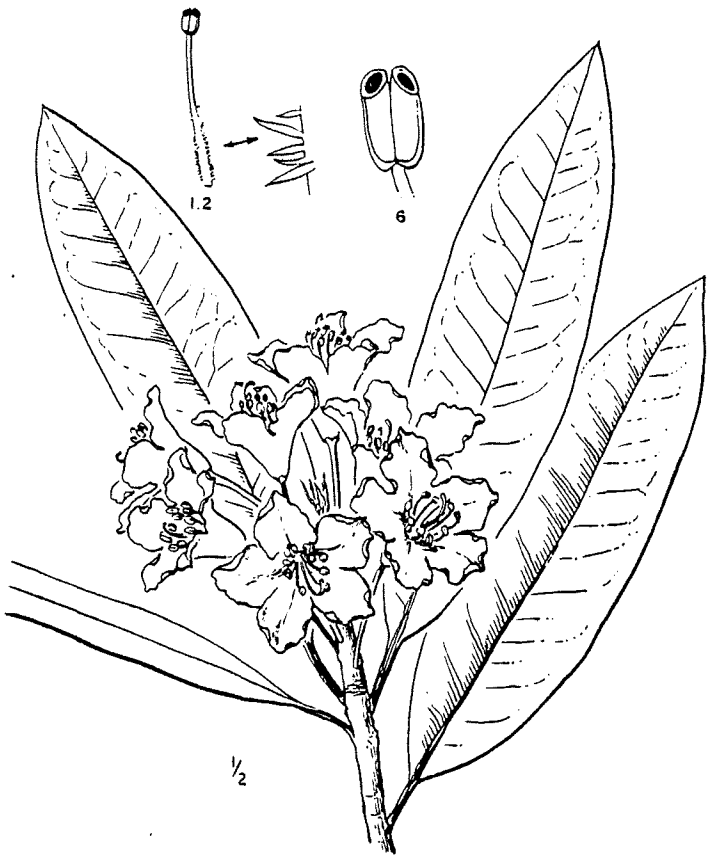
(Pamy)



CASCADES AZALEA, WHITE RHODODENDRON

Rhododendron albiflorum

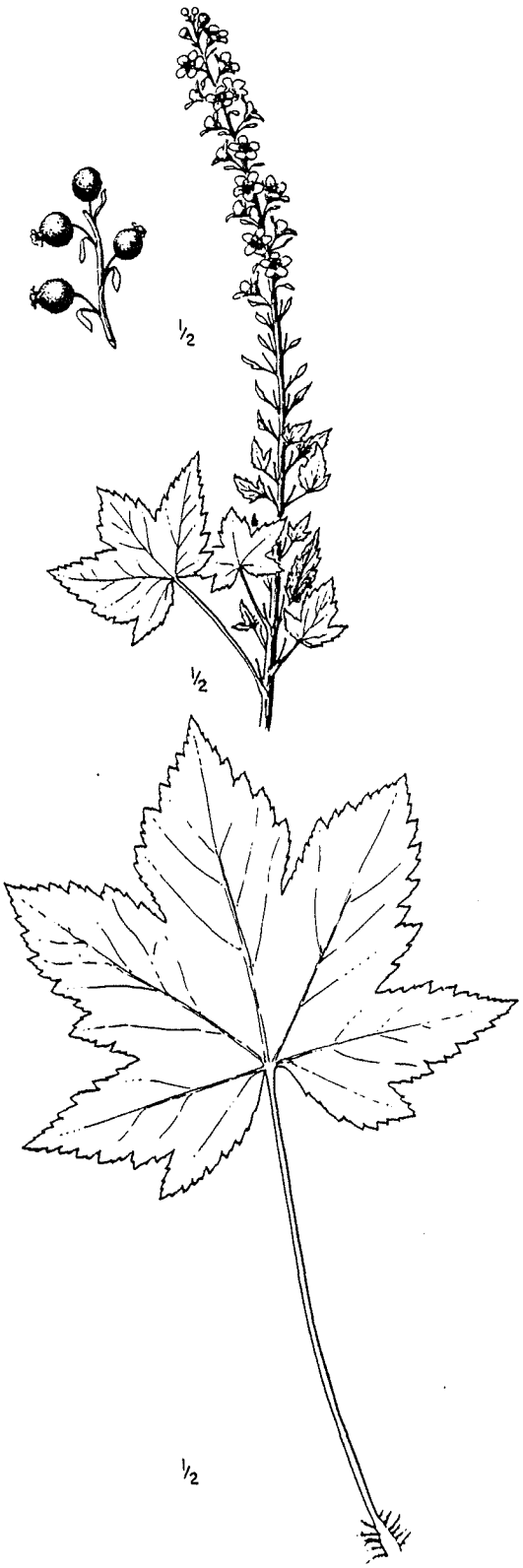
(Rhal)



PACIFIC RHODODENDRON

Rhododendron macrophyllum

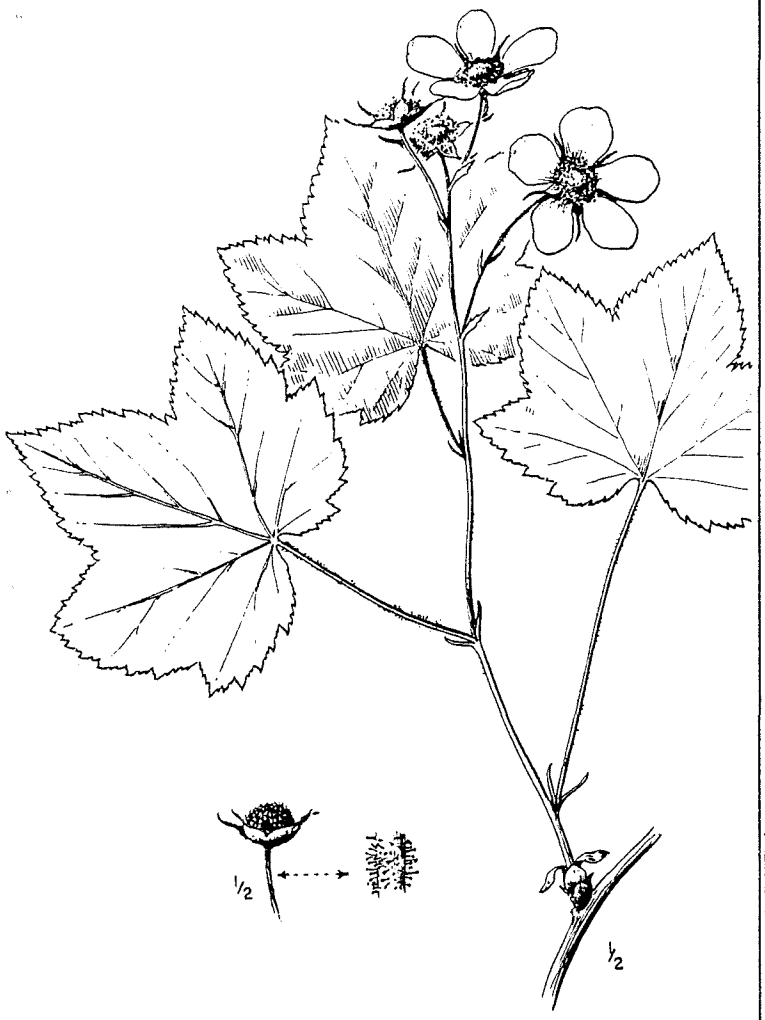
(Rhma)



STINK CURRANT

Ribes bracteosum

(Ribr)



WESTERN THIMBLEBERRY

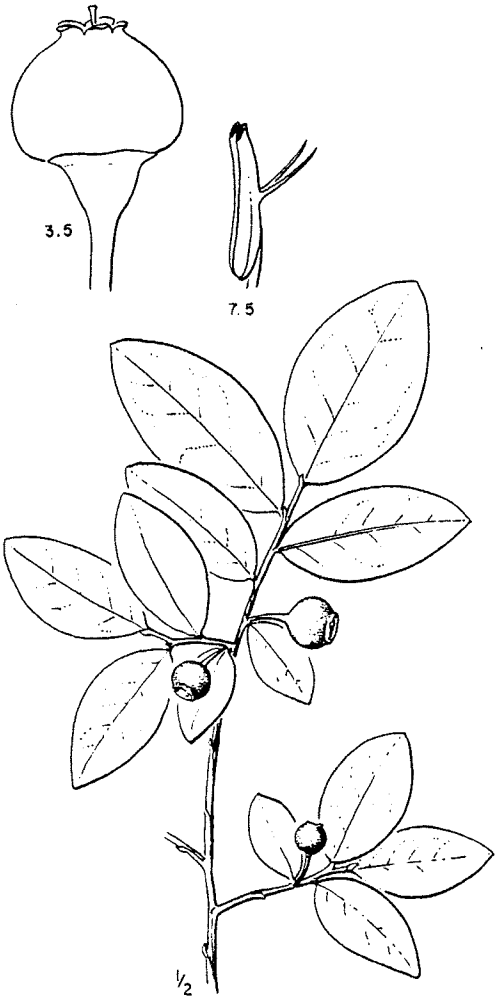
Rubus parviflorus

(Rupa)

SALMONBERRY

Rubus spectabilis

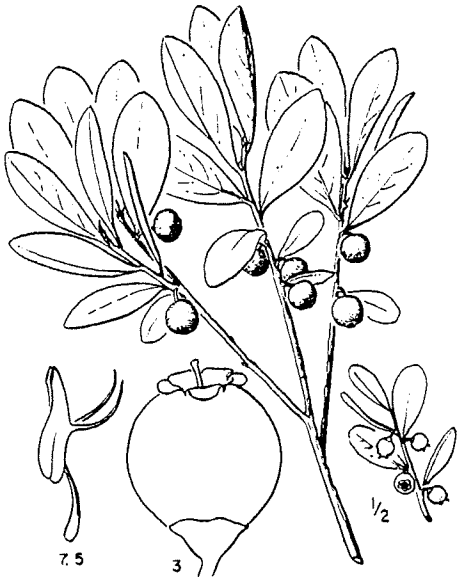
(Rusp)



ALASKA HUCKLEBERRY

Vaccinium alaskaense

(Vaal)



BLUE-LEAF HUCKLEBERRY

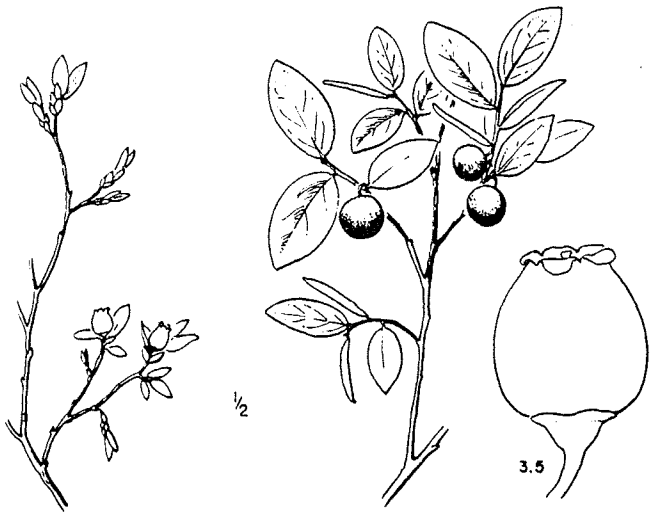
Vaccinium deliciosum

(Vade)

THIN-LEAVED HUCKLEBERRY

Vaccinium membranaceum

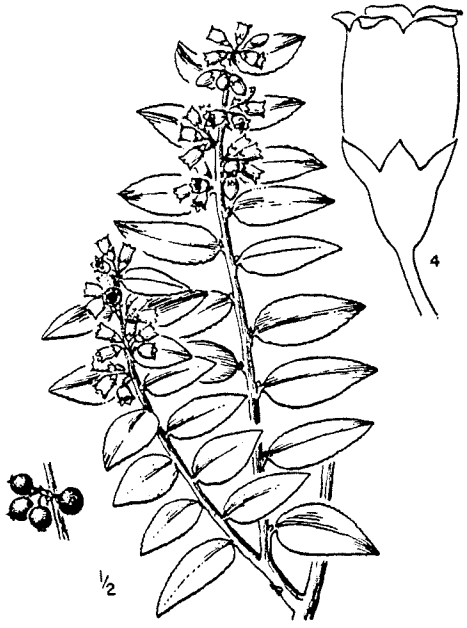
(Vame)



OVAL-LEAF HUCKLEBERRY

Vaccinium ovalifolium

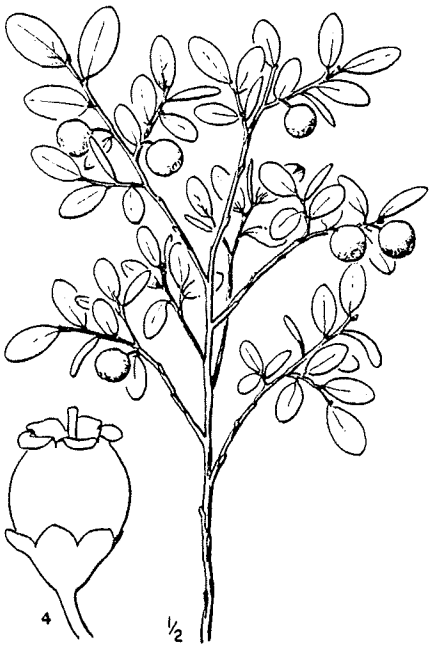
(Vaov)



EVERGREEN HUCKLEBERRY

Vaccinium ovatum

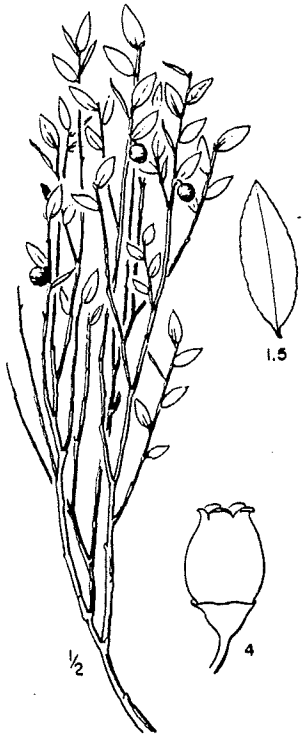
(Vaov2)



RED HUCKLEBERRY

Vaccinium parvifolium

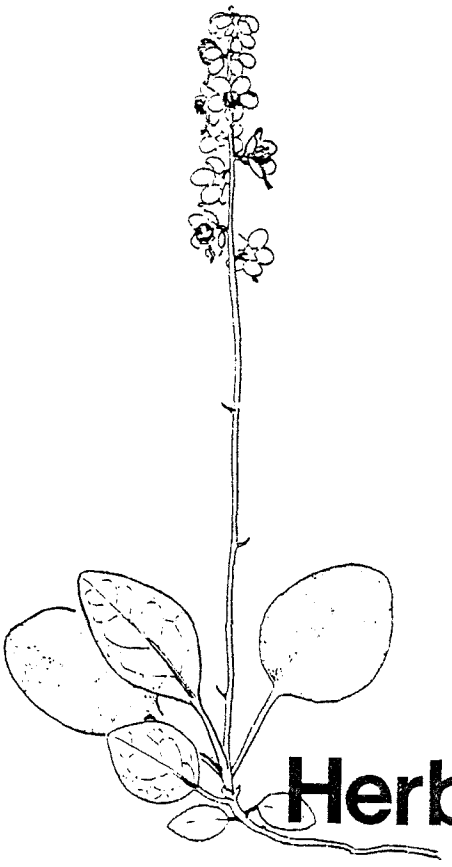
(Vapa)



GROUSE WHORTLEBERRY

Vaccinium scoparium

(Vasc)



Herbs

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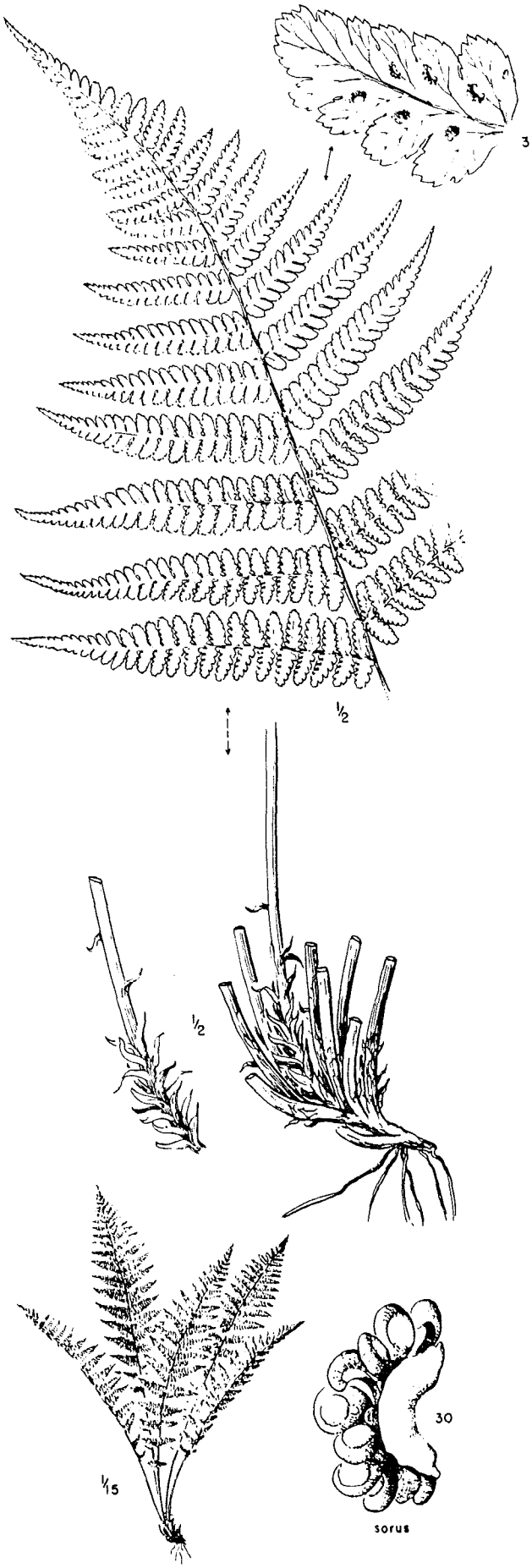
VANILLALEAF

Achlys triphylla

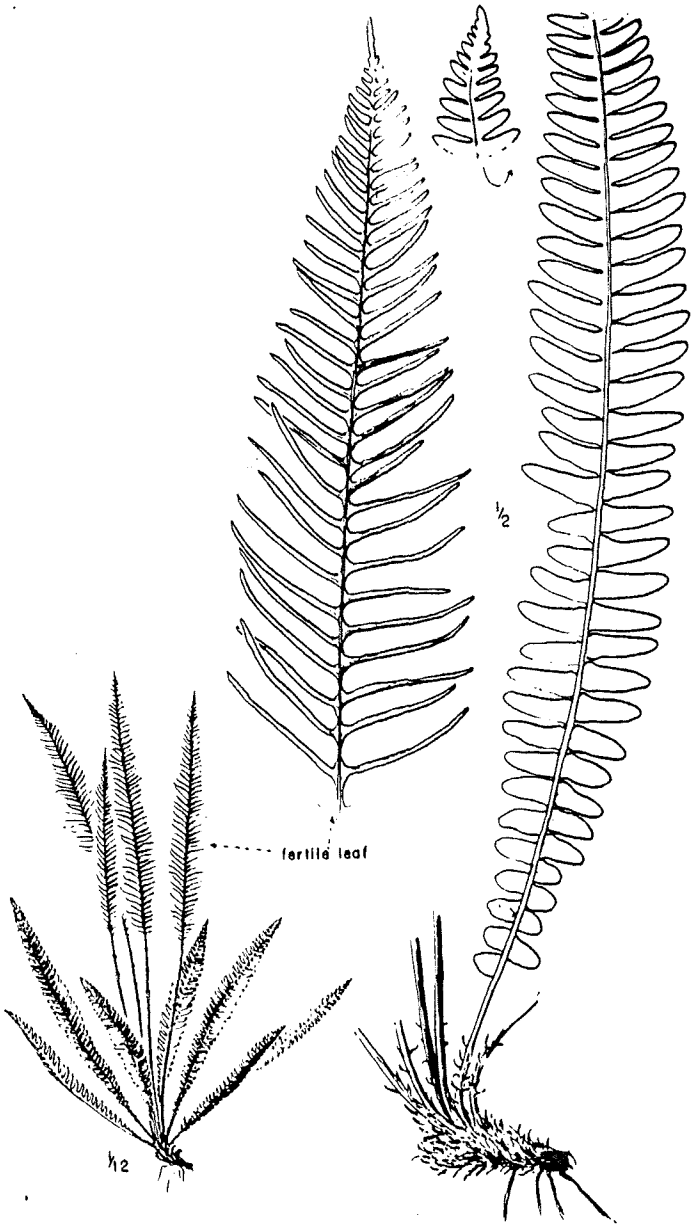
(Actr)



LADY FERN

Athyrium filix-femina

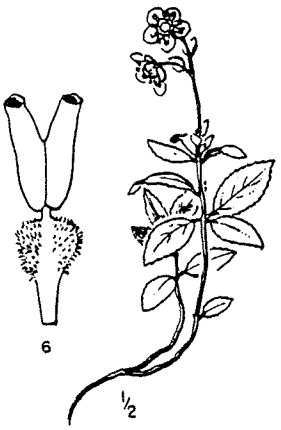
(Atfi)



DEER FERN

Blechnum spicant

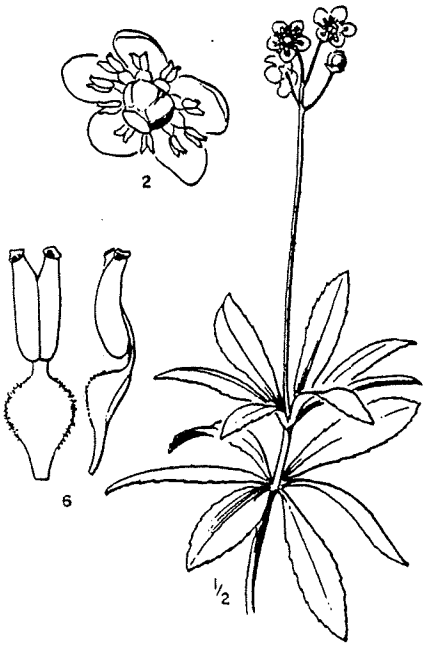
(Blsp)



LITTLE PIPSISSEWA

Chimaphila menziesii

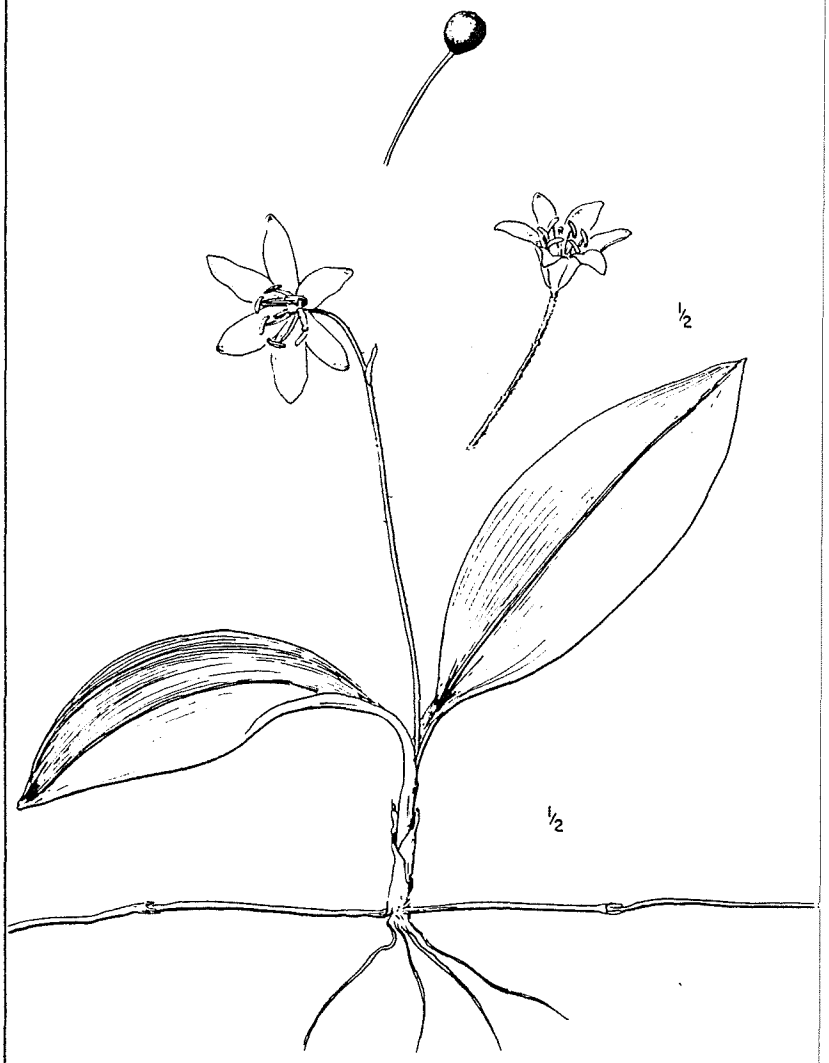
(Chme)



COMMON PIPSISSEWA

Chimaphila umbellata

(Chum)



QUEEN'S CUP

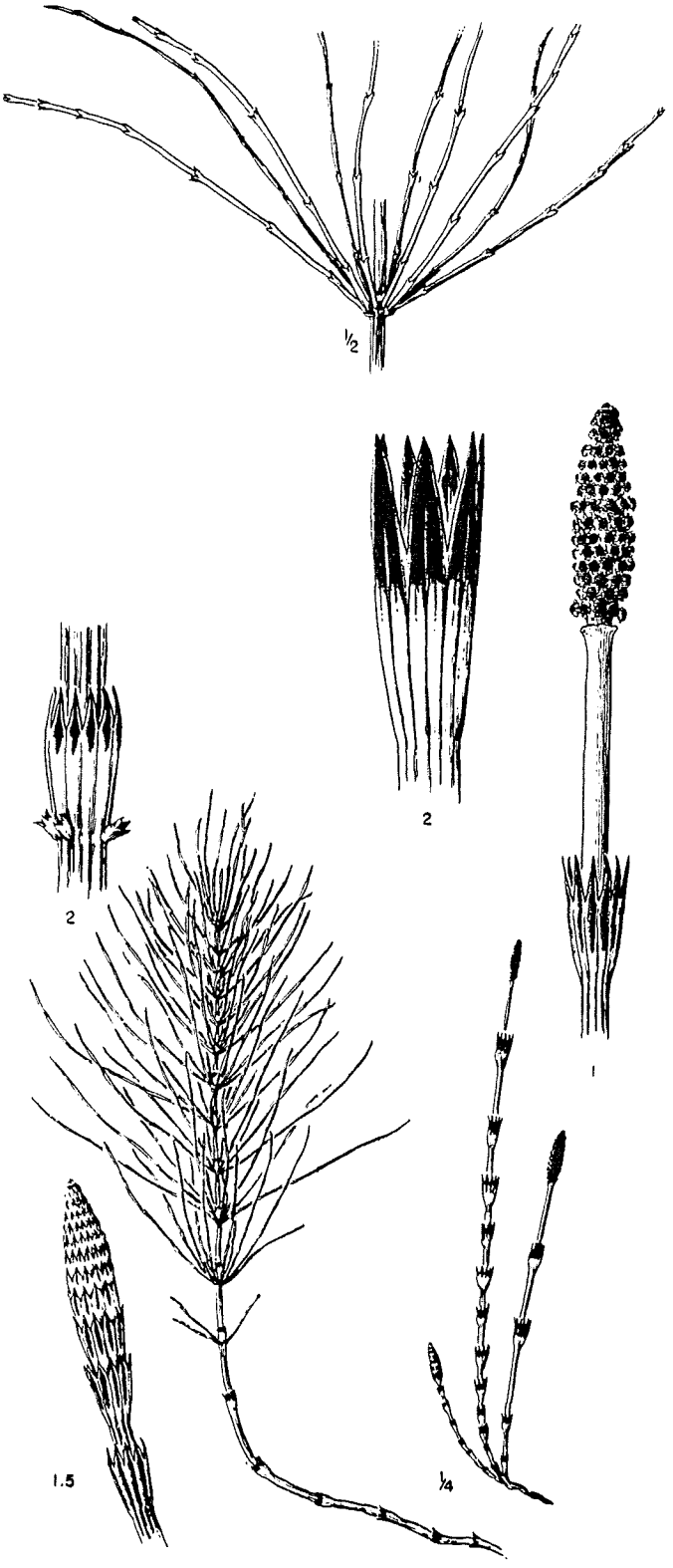
Clintonia uniflora

(Clun)

BUNCHBERRY

Cornus canadensis

(Coca)



COMMON HORSETAIL

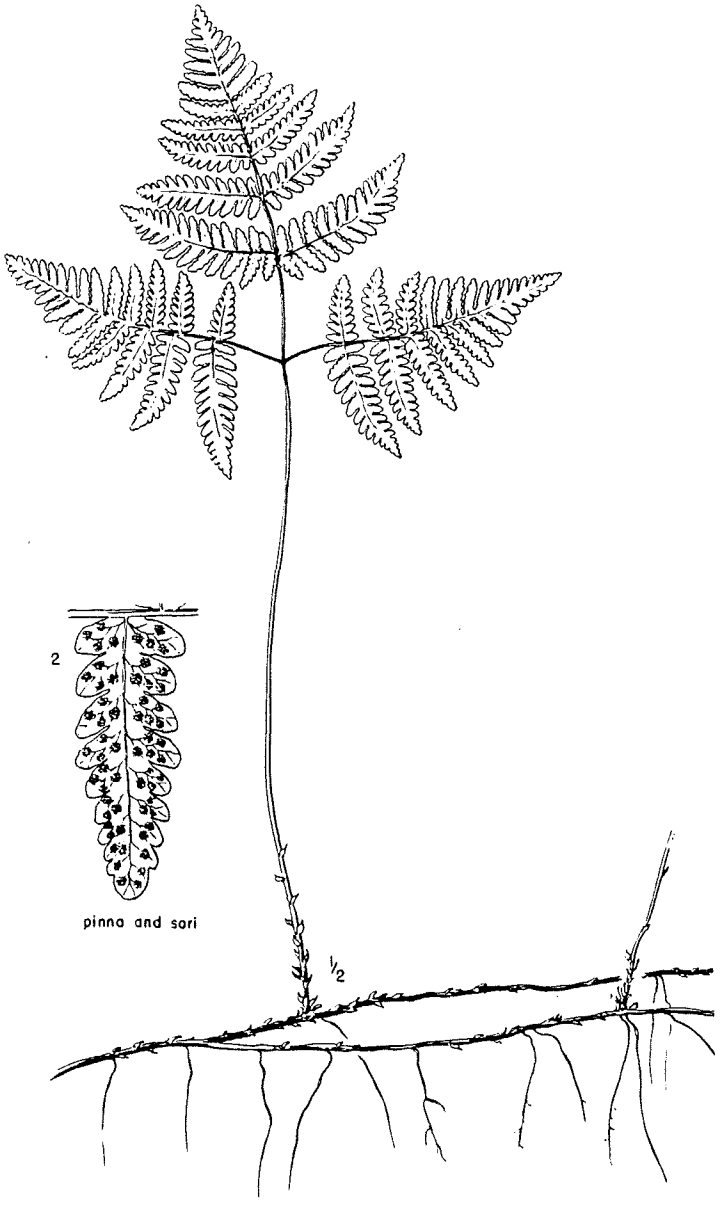
Equisetum arvense

(Eqar)

AVALANCHE FAWNLILY

Erythronium montanum

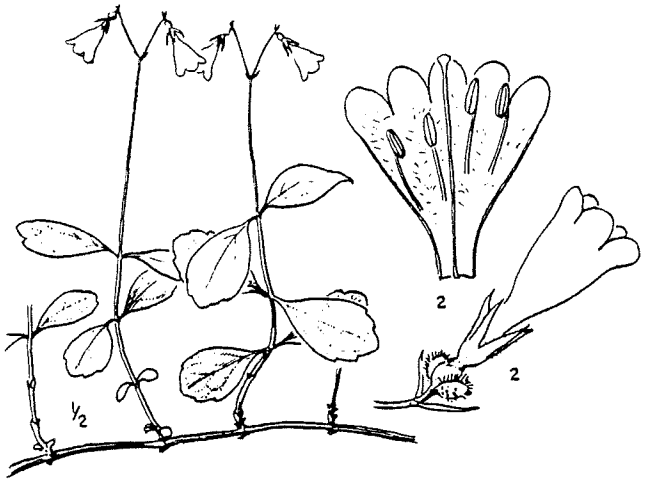
(Ermo)



OAK FERN

Gymnocarpium dryopteris

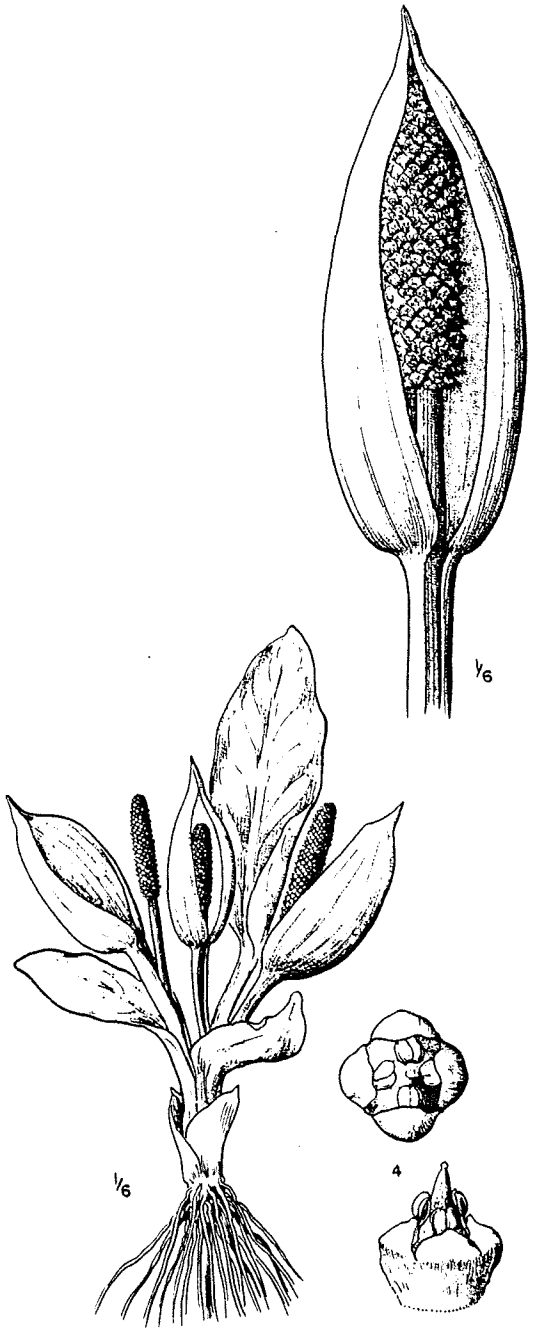
(Gydr)



TWINFLOWER

Linnaea borealis

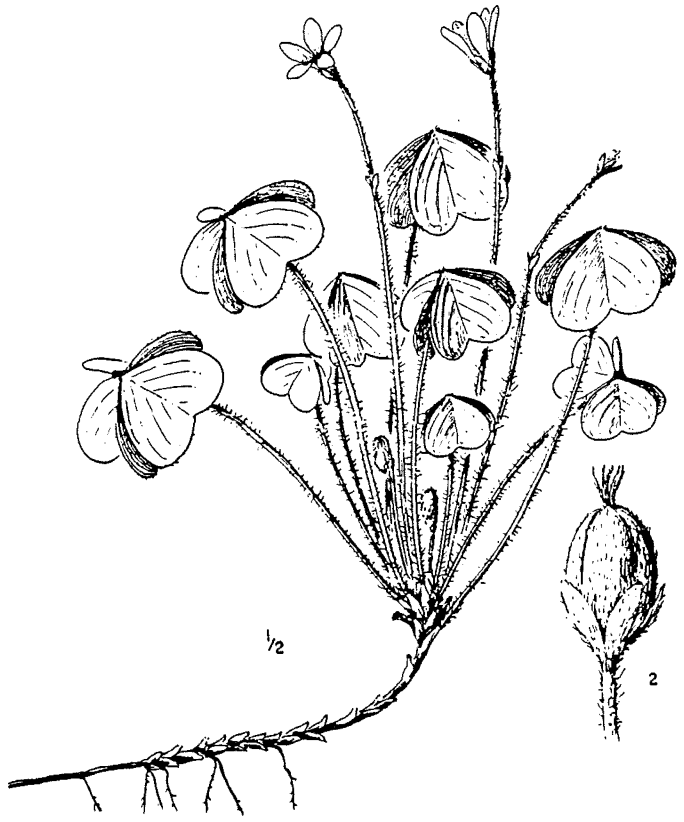
(Libo2)



SKUNK CABBAGE

Lysichitum americanum

(Lyam)



OREGON OXALIS

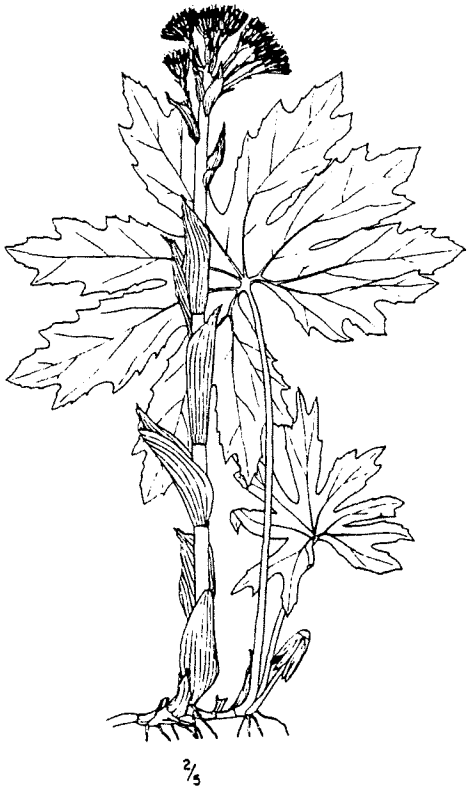
Oxalis oregana

(Oxor)

LEAFY LOUSEWORT

Pedicularis racemosa

(Pera)

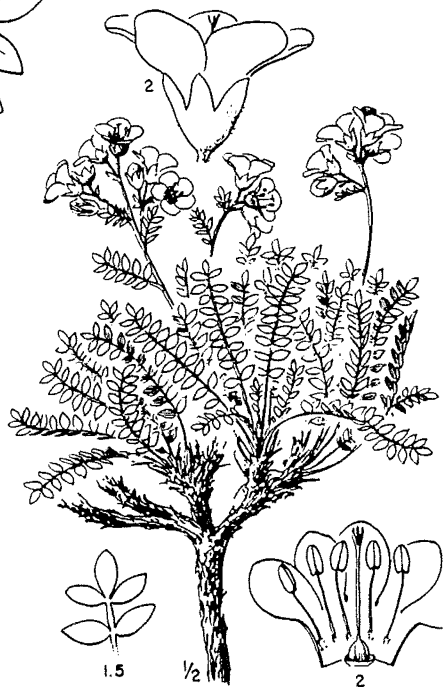


SWEET COLTSFOOT

Petasites frigidus palmatus

(Pefrp)

Polemonium pulcherrimum var. calycinum

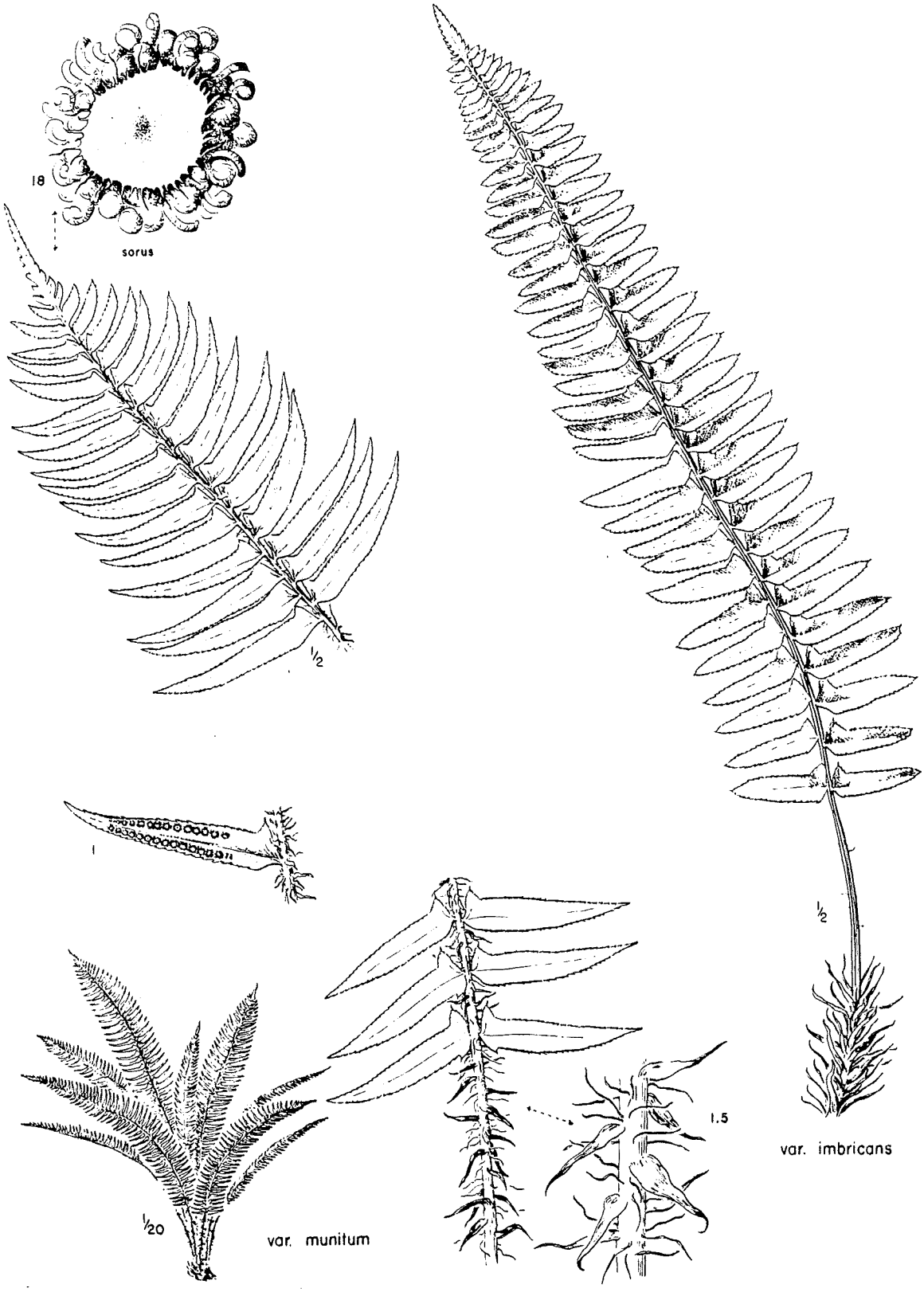


P. pulcherrimum var. pulcherrimum

SKUNKLEAF POLEMONIUM

Polemonium pulcherrimum

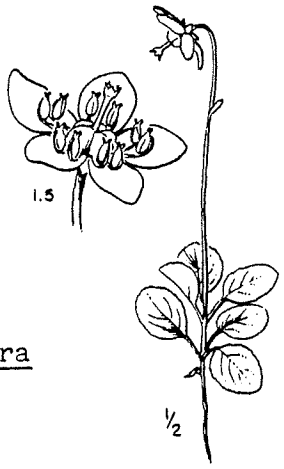
(Popu)



SWORDFERN

Polystichum munitum munitum

(Pomum)

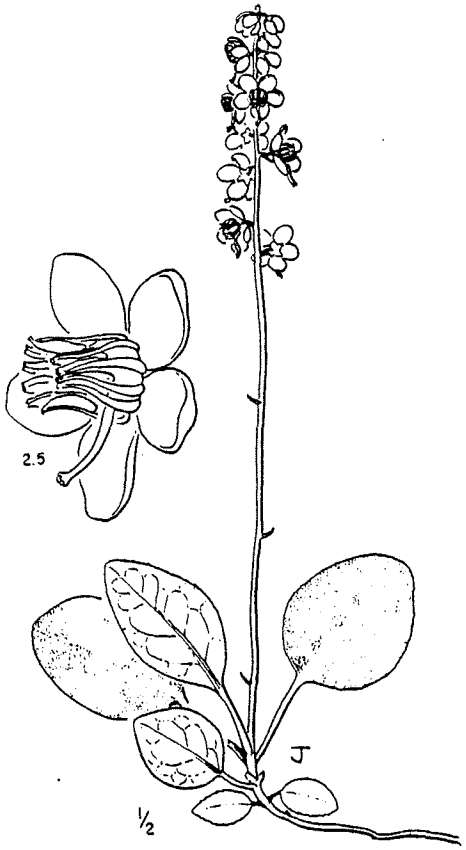


P. uniflora

WOODNYMPH

Pyrola uniflora

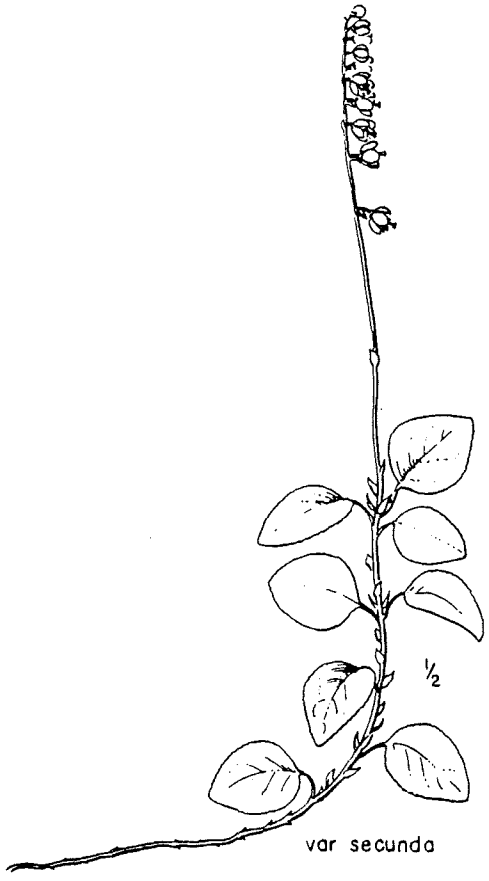
(Pyun)



WHITEVEIN PYROLA

Pyrola picta

(Pypi)

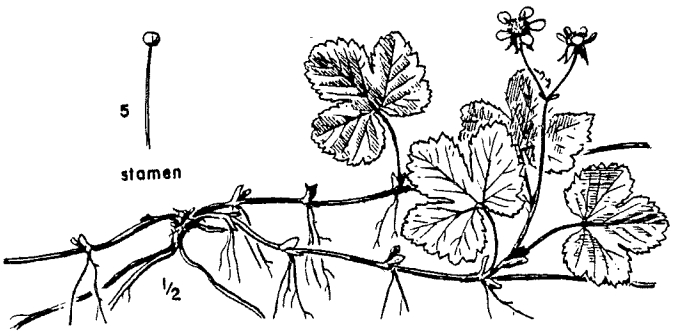


var secunda

ONE-SIDED PYROLA

Pyrola secunda

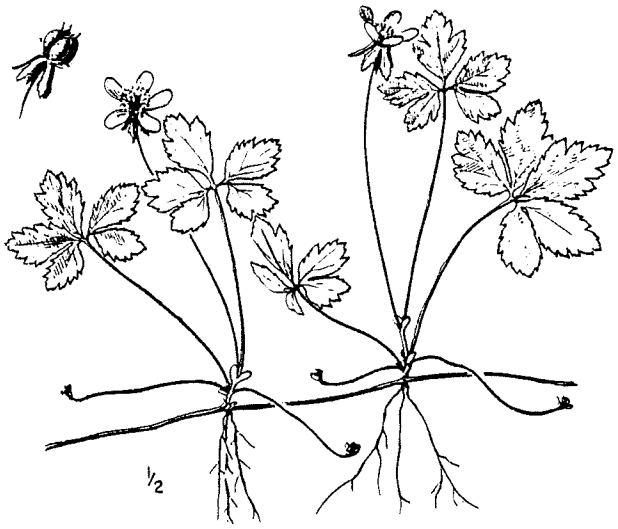
(Pyse)



DWARF BRAMBLE, TRAILING B.

Rubus lasiococcus

(Rula)



FIVE-LEAVED BRAMBLE, TRAILING B.

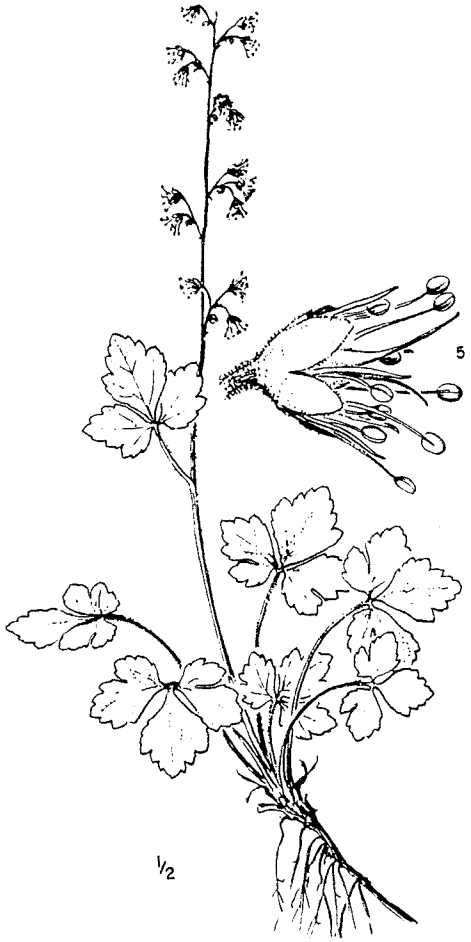
Rubus pedatus

(Rupe)

ROSY TWISTED-STALK

Streptopus roseus

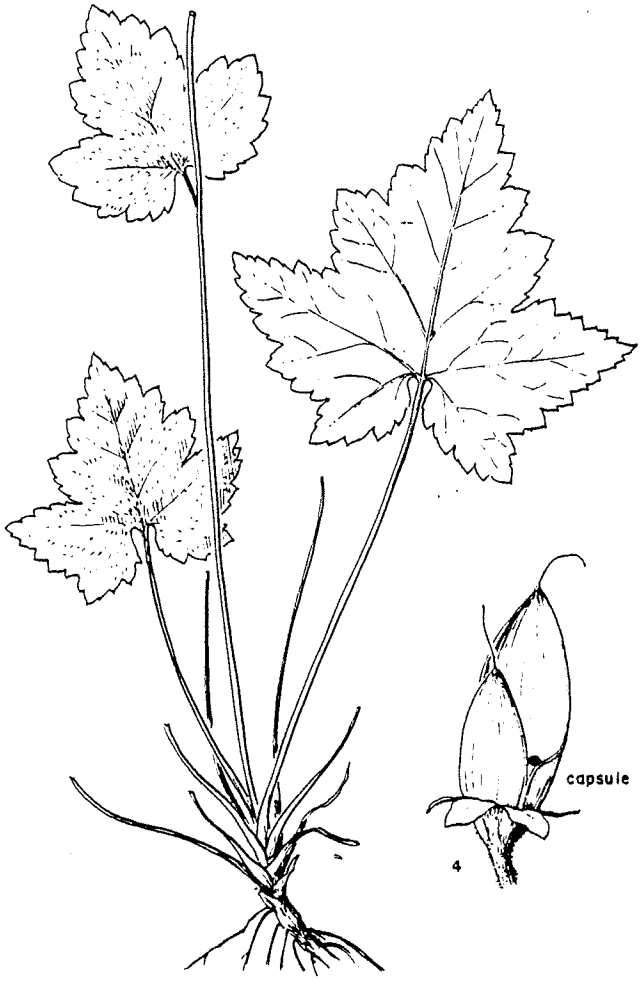
(Stro)



THREE-LEAVED FOAMFLOWER

Tiarella trifoliata

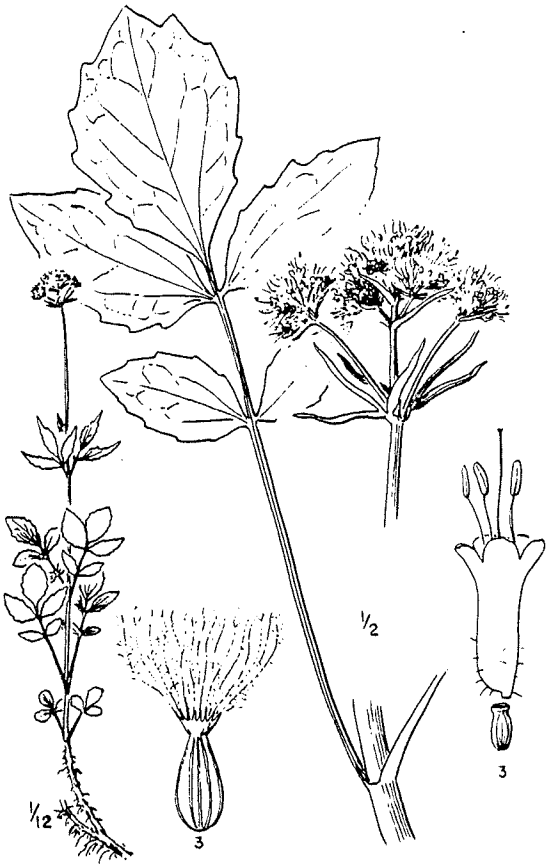
(Titr)



ONE-LEAVED FOAMFLOWER

Tiarella unifoliata

(Tiun)



SITKA VALERIAN

Valeriana sitchensis

(Vasi)

COMMON BEARGRASS

Xerophyllum tenax

(Xete)

FIELD FORM

Crew _____			Plot		
Location _____			Elev.		
Location _____			Aspect		
Location _____			Slope		
TREES					
Abies amabilis	(Abam)	Silver fir			
Chamaecyparis nootkatensis	(Chno)	Alaska yellow cedar			
Pseudotsuga mensiesii	(Psme)	Douglas-fir			
Abies procera	(Abpr)	Noble-fir			
Thuja plicata	(Thpl)	Western redcedar			
Tsuga heterophylla	(Tshe)	Western hemlock			
Tsuga mertensiana	(Tsme)	Mountain hemlock			
Abies lasiocarpa	(Abla2)	Subalpine fir			
SHRUBS					
Acer circinatum	(Acci)	Vine maple			
Berberis nervosa	(Bene)	Oregongrape			
Gaultheria shallon	(Gash)	Salal			
Holodiscus discolor	(Hodi)	Oceanspray			
Menziesia ferruginea	(Mefe)	Fool's huckleberry			
Oplopanax horridum	(Opho)	Devil's club			
Rhododendron albiflorum	(Rhal)	White rhododendron			
Ribes bracteosum	(Ribr)	Stink currant			
Rubus spectabilis	(Rusp)	Salmonberry			
Vaccinium alaskaense	(Vaal)	Alaska huckleberry			
Vaccinium membranaceum	(Vame)	Thinleaved huckleberry			
Vaccinium ovalifolium	(Vaov)	Ovalleaf huckleberry			
Vaccinium ovatum	(Vaov2)	Evergreen huckleberry			
Vaccinium parvifolium	(Vapa)	Red huckleberry			

HERBS

Achlys triphylla	(Actr)	Vanillaleaf			
Athyrium filix-femina	(Atfi)	Lady fern			
Blechnum spicant	(Blsp)	Deer fern			
Chimaphila menziesii	(Chme)	Little pipsissewa			
Chimaphila umbellata	(Chum)	Common pipsissewa			
Clintonia uniflora	(Clun)	Queen's Cup			
Cornus canadensis	(Coca)	Bunchberry			
Gymnocarpium dryopteris	(Gydr)	Oak fern			
Linnaea borealis	(Libo2)	Twinflower			
Oxalis oregana	(Oxor)	Oxalis			
Polystichum munitum	(Pomu)	Swordfern			
Pyrola secunda	(Pyse)	One-sided pyrola			
Rubus lasiococcus	(Rula)	Dwarf bramble			
Rubus pedatus	(Rupe)	Five-leaved bramble			
Streptopus roseus	(Stro)	Rosy twistedstalk			
Tiarella trifoliata	(Titr)	Three-leaved foamflower			
Tiarella unifoliata	(Tiun)	One-leaved foamflower			
Xerophyllum tenax	(Xete)	Beargrass			

Key to the major Association in the Green and Cedar River Drainages, Mt. Baker-Snoqualmie National Forest

1. Mountain hemlock (Tsme) ≥ 10% cover . . . . . (2)

    2. White rhododendron (Rhal) ≥ 5% cover. . . . . Tsme/Rhal (TBE)
    2. Rhal < 5% . . . . . (3)

        3. Alaska huckleberry (Vaal) ≥ 10% cover . . . . . Tsme/Vaal p. 19
        3. Vaal < 10% . . . . . (4)

            4. Thinleaved huckleberry (Vame) ≥ 10% cover . . Tsme/Vame (TBE)
            4. Beargrass ≥ 10% cover . . . . . Tsme/Xete p. 20

1. Tsme < 10% . . . . . (5)

    5. Silver fir (Abam) ≥ 10% cover . . . . . (6)

        6. Devil's club (Opho) ≥ 5% cover . . . . . Abam/Opho p. 26
        6. Opho < 5% . . . . . (7)

            7. Alaska huckleberry ≥ 10% cover . . . . . Abam/Vaal p. 27
            7. Vaal < 10% . . . . . (8)

                8. Oregongrape (Bene) ≥ 10% or Bene and Salal (Gash) combined ≥ 15% . . . . . Abam/Bene p. 31
                8. Thinleaved huckleberry (Vame) ≥ 10% . . . Abam/Vame p. 33

    5. Silver fir (Abam) < 10% cover, western hemlock (Tshe) ≥ 10% cover . . . . . (9)

        9. Devil's club (Opho) ≥ 10% cover . . . . . Tshe/Opho p. 39
        9. Opho < 10% . . . . . (10)

            10. Alaska huckleberry ≥ 10% cover . . . . . Tshe/Vaal p. 40
            10. Vaal < 10% . . . . . (11)

                11. Salal (Gash) ≥ 10% cover . . . . . Tshe/Gash p. 41
                11. Gash < 10% . . . . . (12)

                    12. Swordfern (Pomu) ≥ 10% cover . . . . Tshe/Pomu p. 43
                    12. Pomu < 10% . . . . . (13)

                        13. Oregongrape (Bene) ≥ 5% cover . . Tshe/Bene p. 45
                        13. Bene < 5%, vine maple (Acci) ≥ 10% cover . . . . . Tshe/Acci (TBE)